Buck Lake Summary

Table 1. Buck Lake Information

Municipal Township	**Township of South Frontenac**
Geographic Townships	**Bedford, Loughborough & Storrington**
Quarternary Watershed	**Cataraqui River**
Flows Into	**Mississagua Creek to Mosquito Lake**
Surface Area	**755 hectares (1865 acres)**
Maximum Depth	**40.9 meters (134 feet)**
Mean Depth	**11.9 meters (39 feet)**
Shoreline Perimeter	**45.9 km (28.5 miles)**
Crown Land	**10% (in 1976 for north bay)**
pH	**8.5-7**
Secchi Depth (average 2008-2010)	**3.6 meters**
Total Phosphorus Concentration (spring turnover average 2008-2010)	**10.9 ug/L**
Total Dissolved Solids	**125 mgL^{-1}**
Flushing Rate: **South Basin** **North Basin**	 **0.28 times/year** **0.12 times/year**
Maximum Sustainable Lake Trout Harvest	**1.1 kg/ha/yr**
Maximum Sustainable Angling Effort	**4.33 hr/ha/yr**
Mean Volume-Weighted Hypolimnetic Dissolved Oxygen concentration	**South Basin between 5.91 and 6.44** **North Basin between 2.33 and 4.75**
Current Known Fish Species Present	**Lake trout, lake herring (cisco), northern pike, smallmouth bass, largemouth bass, yellow perch, pumpkinseed, bluegill, black crappie, rock bass, brown bullhead, logperch, bluntnose minnow, common shiner. Historical occurrence of splake and walleye due to stocking.**

Shoreline Development

The following table is a summary of shoreline development on lake trout lakes in the County of Frontenac. This information was current in 1993 thus may need to be updated for many lakes.

Table 2. Shoreline development on Buck Lake compared to other lake trout lakes located in the

County of Frontenac

Lake	No. Residences			No. Private Vacant Lots	Tourism Establishments			Provincial Park Campsites
	Permanent	Seasonal	Total		Number	Rooms and/or cabins	Campsites	
Buck	**15**	**253**	**268**	**136**	**3**	**10**	**20**	**4**
Big Clear	?	14	14	8	0	0	0	3
Big Ohlman	1	3	4	n.a.	0	0	0	0
Big Salmon	0	0	0	0	0	0	0	10
Birch	?	8	8	n.a.	1	?	15	8
Green Bay of Bobs	?	87	87	49	?	48	?	0
Canoe	3	21	24	26	2	7	77	0
Crow	11	78	89	38	6	37	31	0
Desert	12	57	69	32	4	27	115	0
Devil	21	188	209	80	4	19	49	4
Eagle	17	162	179	70	?	?	?	0
Gould	2	24	26	n.a.	0	0	0	0
Kishkebus	0	0	0	0	0	0	0	?
Knowlton	9	36	45	15	0	0	0	0
Little Green	?	7	7	1	1	0	10	0
Little Mackie	0	0	0	0	0	0	0	0
Loughborough (West Basin)	110	233	343	82	6	35	163	0
Lucky	0	1	1	0	1	4	0	0
Mackie	1	41	42	1	2	37	0	0
Mosque	?	43	43	3	0	0	0	0
Palmerston	11	92	103	50	3	26	0	0
Potspoon	3	14	17	5	0	0	0	0
Reid	0	0	0	0	0	0	0	0
Round								
Schooner	0	0	0	0	0	0	0	0
Shabomeka	1	102	103	11	0	0	0	0
Sharbot (West Basin)	34	128	162	39	3	31	0	185
Silver	5	51	56	12	1	18	0	148
Brule	2	74	76	7	2	8	0	0

Management History

- Walleye and Smallmouth Bass were stocked semi-regularly from 1935-1948
- Smallmouth and Largemouth Bass were stocked a few times each from 1951-1956
- Muskellunge were stocked once in 1965
- Splake were stocked annually from 1984-1989
- Lake Trout were stocked once in 1949 and annually from 1959-1989

Table 3. Buck Lake stocking history summary

Species	First Year of Stocking	Last Year of Stocking	Number of stockings	Average number of stocked fish/year
Walleye	1935	1948	4	187,500

Smallmouth Bass	1935	1956	11	2,863
Largemouth Bass	1954	1955	2	3,800
Muskellunge	1965	1965	1	5,000
Lake Trout	1949	1989	32	3,857
Splake	1984	1989	6	4,122

- **1954- (August)** Gill netting. Total catch= 1 Northern Pike, 10 Smallmouth Bass, 14 Lake Herring, 2 Brown Bullhead, 5 Pumpkinseed, 3 Bluegill, 5 Rock Bass, 1 Black crappie.

- **1954-** Hoop netting. Total catch= 2 splake, 21 Largemouth Bass, 24 Brown Bullhead, 10 Yellow Perch, 71 Pumpkinseed, 77 Bluegill, 5 Rock Bass, 14 Black Crappie**.**

- **1960-** Lake survey done.

- **1960- (August)** Gill netting done over 6 days. Total catch= 16 lake trout, 4 northern pike, 6 walleye, 7 smallmouth bass, 17 largemouth bass, 30 lake herring, 3 brown bullhead, 3 white sucker, 8 yellow perch, 83 pumpkinseed, 165 bluegill, 38 rock bass, 14 black crappie.

- **1968-76-** Creel surveys done on several occasions. See *Creel Surveys* section for more details.

- **1972- (June)** 4 overnight net sets. Total catch= 4 Northern Pike, 20 Lake Herring, 6 Yellow Perch, 2 Yellow Bullhead, 2 Bluegill, 7 Lake Trout.

- **1972-** Report on water quality including bacteriology, list of aquatic plants, chemistry, and clarity. Water quality was found to be within MOE standards.

- **1971-72-** Lake Survey done.

- **1975-** Water chemistry data taken.

- **1978-** Water chemistry data taken.

- **1978-** Extensive creel report done. See *Creel Surveys* section for more details.

- **1984 (Oct.)** - 100' 2 ¼" nets overnight. Total catch= 9 lake trout (all tagged) (Nov)- 150', 1.5, 2, 2.5" overnight= 6 lake trout (all tagged)

- **1992 – (April and May)** SLIN project carried out. (3 nets, 3 panels)Total Catch= 47 Lake Trout, 363 Yellow Perch, 137 Lake Herring, 9 Smallmouth Bass, 10 Northern Pike, 25 Bluegill, 71 Common Shiners, 12 Black crappie, 71 Pumkinseed, 8 Splake, 1 Whitefish, 1 brown Bullhead, 4 Largemouth bass. More details on the netting are in the *Fisheries Assessment* section below.

- **1992- (June and July)** Nearshore habitat mapping report- identified and mapped critical spawning sites. Listed some plant and animal species. See *Non-Fish Species* section for more details. Seine netting was also carried out. Total catch for seine netting= 2 Smallmouth bass, 15 Largemouth bass, 5 rock bass, 135 bluegill, 124 pumpkinseed, 160 bluntnose minnow, 78 log perch and 9 yellow perch.

- **1993- (May)** SLIN 90 min. Gill net sets (3 sets, 3 panels). Total catch= 79 Lake trout, 124 Lake herring, 1 Rock Bass, 4 Pumpkinseed, 2 Blue Gill, 3 Smallmouth Bass, 44 Yellow Perch. See *Fisheries Assessment* section for details.

- **1997- (May)** SLIN- 59 nets for 30 mins. Total catch= 26 lake trout, 31 Lake herring, 4 Northern pike, 17 perch, 1 Smallmouth bass, 2 whitefish. See *Fisheries Assessment* section for details

- **2005 (Sept.)-** Water quality and chemistry data taken. See *Water Quality* section for details.
- **2007 (July)** – SPIN project carried out. Total catch= 41 Lake Trout, 38 Lake Herring, 9 Smallmouth Bass. See *Fisheries Assessment* section for details.
- **2007 (Sept.)** - Water quality data taken. See *Water Quality* section for details.
- **2008 –** Fish spawning habitat was looked at and mapped. Several lake trout spawning locations and bass and sunfish nests were recorded. See *Fisheries Assessment* section for details**.**
- **2008 (Sept.) -** Water quality data taken. See *Water Quality* section for details
- **2010 (Aug/Sept) –** NSCIN carried out

Status of Fish Community

Standard Netting Surveys

The Ministry of Natural Resources has developed netting surveys that follow specific standard protocols in an effort to assess the status of various fish communities across this large province. Following these standard netting surveys can help managers to compare how a fish species and/or fish community is doing in a specific lake relative to the last time it was surveyed. It also allows for comparisons of that species/community to the same in other lakes surveyed by the same methods. A standard protocol means using the same types of nets (size, configuration, color) and also netting within the same seasons which is usually dictated by water temperature. There are also specific portions of the water column that are sampled and all nets are set at randomly selected sites.

Three separate standard netting surveys have been used on Buck Lake since 1992.

Three Spring Littoral Index Netting (SLIN) surveys were carried out on Buck Lake during the springs of 1992, 1993 and 1997. SLIN is considered a low impact method of monitoring lake trout abundance in Ontario Lakes. The survey randomly samples the area of a lake adjacent to shore from depths of 2.5 to 60 meters (no nets are set deeper than 60 m). The survey is carried out in the spring using 91 meter long gill nets with small mesh sizes of 38 mm, 51 mm or 64 mm (1.5 in, 2.0 in, 2.5 in) and the nets are only left in the lake for short periods of time (30 or 90 minutes). The original standard survey called for nets to be left in the water for only 30 minutes but has since been modified to 90 minutes to ensure adequate catches of lake trout for analysis purposes. Lake trout is a species that prefers to live where water temperatures are 9 to 13 °C and is a dominant predator in the shallow near shore area during the spring, before warming of the surface waters forces its retreat into deeper water. This survey is carried out after ice melt and before the surface water temperatures warm to 13 °C. Small mesh is effective in entangling (not wedging) adult-sized lake trout. Combined with a short set duration, it avoids the high mortality that typically results from gill net surveys. On average, only 10% of lake trout caught in SLIN gill nets are killed.

A Summer Profundal Index Netting (SPIN) survey was carried out on Buick Lake during July and August of 2007. SPIN is a relatively new standard netting protocol developed to assess lake trout populations and is guided by two basic objectives:

1. Obtain a point-in-time estimate of the relative area-weighted density of lake trout >30 cm in length

2. Obtain a representative sample of the population of lake trout (>30 cm) to determine a number of diagnostic characteristics to assess the biological integrity of the population

The SPIN methodology utilizes a range of eight gill net mesh sizes (2.25" to 5.0") which have been determined to primarily target lake trout greater than 30 cm. Anglers tend to harvest lake trout in this size range, hence, consequences of exploitation should be detectable from this segment of the population. Furthermore, this limit on the minimum size of fish targeted improves the low mortality feature of the index by avoiding very small lake trout which appear to be unable to regulate swim bladder volume on ascent. The nets are 210' in length and set for two hours.

The current operational window for SPIN is between July 15 and September 15 or before visible signs of thermocline collapse. This will ensure that lakes are near the maximum extent of summer stratification, that a large proportion of the annual growth has occurred and the potential for fall spawning movement and/or behavior affecting catch success is minimal. Nets are set between 10m and 40 m depths which is where the majority of lake trout >30 cm are anticipated to be concentrated during this period of time.

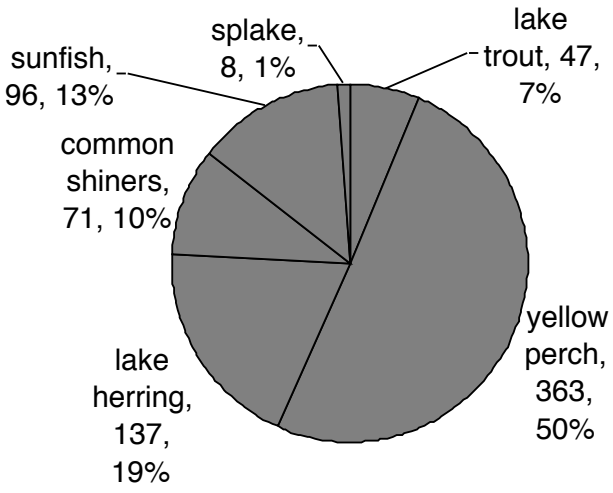
A Nearshore Community Index Netting (NSCIN) survey was carried out on Buck Lake during late August and early September of 2010. A NSCIN survey is a standard live release trap netting program designed to evaluate the relative abundance and other measurements of fish species living in the near shore area of a lake. This area of the lake is often referred to as the littoral zone and, for this survey, includes the part of the lake from shore out to 46 meters and down to a depth of 3.5 meters. The survey is to be carried out from August until the surface water temperatures cool to 13 °C in the fall. Trap nets were set for 24 hours at 14 different randomly selected sites around the lake.

Fish Community

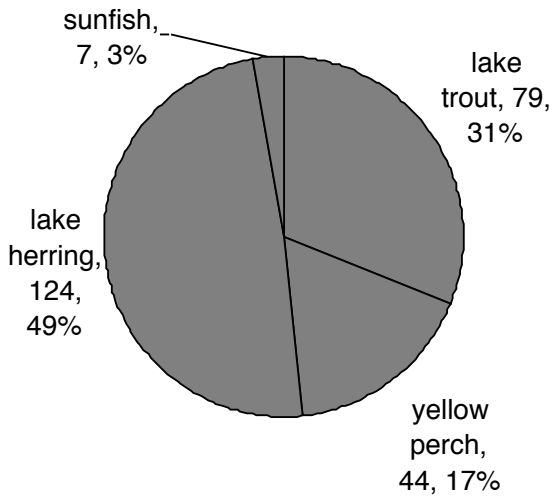
The following three charts illustrate the number and relative abundance (% of total catch) of each species caught during the three SLIN projects, early spring season in the area from shore out 90 meters and deeper than 2.5 meters.

Figure 1. Relative abundance of early spring fish community in Buck Lake expressed as numbers of fish caught & percentage of each species of total catch per survey

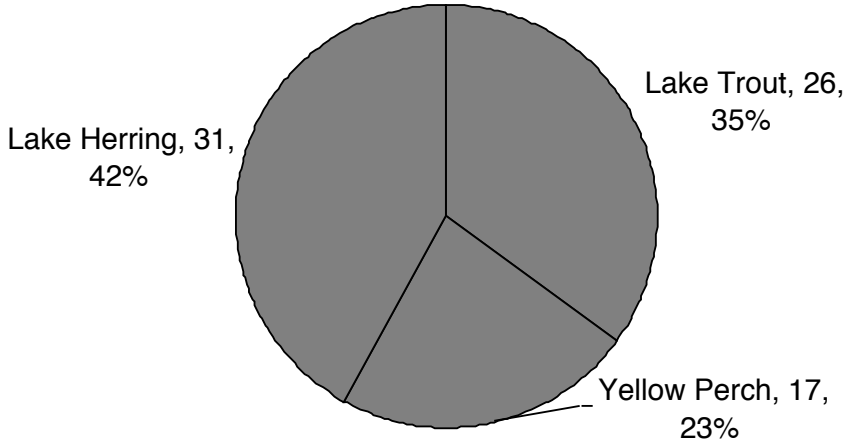
1992 Survey Year (102 nets set for 30 minutes)



1993 Survey Year (56 nets set for 90 minutes)



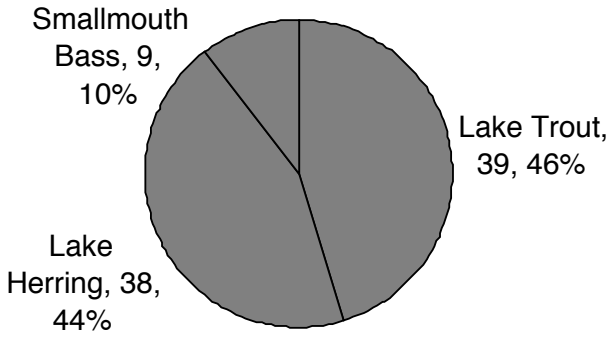
1997 Survey Year (59 nets set for 30 minutes)



- lake herring, yellow perch and lake trout tend to dominate the area of the lake surveyed by SLIN
- fish species such as sunfish, rock bass and bass do not become very active until water temperatures warm to 15 °C thus are not as likely to be caught in nets during the early spring
- the higher relative abundance of sunfish, common shiners and splake encountered in 1992 are likely due to the fact the double the number of sites were sampled thus more of a chance of catching a wider variety of species and some large schools of perch and shiners
- splake were only captured in the north basin and the majority of lake trout (96%) were captured in the south basin
- lake trout likely eat the young stocked splake thus this species survived better in the north basin with fewer lake trout present

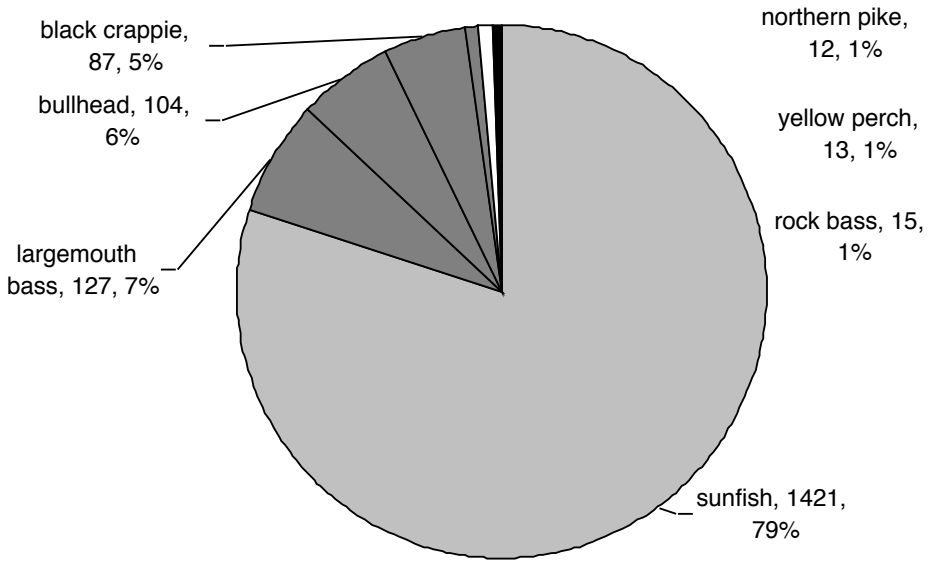
The following chart shows the number and relative abundance (% of total catch) of fish species captured in the 2007 SPIN survey, during summer period within the cold water habitat portion of the basins deeper than 10 meters.

Figure 2. Relative abundance of summer cold-water fish community located below the 10 meters (33 feet) depth in Buck Lake expressed as numbers of fish caught & percentage each species represents of total catch



The following chart shows the number and relative abundance (% of total catch) of fish species captured in the 2010 NSCIN survey, early fall season in the littoral zone of lake out 46 meters from shore and to a depth of 3.5 meters.

Figure 3. Relative abundance of the nearshore zone of Buck Lake expressed as numbers of fish caught & percentage each species represents of the total catch



Lake Trout Status

- despite no lake trout stocking occurring since 1989**,** their numbers remained relatively constant through the 1990's
- refer to the following table for a comparison of the average lake trout catch per hour from all three SLIN surveys
- There was not a statistically significant difference in the number of lake trout caught per hour in any of the three years. Seasonal and environmental variability may be responsible for the slight differences

Table 4. Spring littoral index netting results from three surveys done in the 1990's on Buck Lake

Year of SLIN Survey	Average catch per hour (95% confidence limits)	Number of net sets (net set duration, minutes)	Number of lake trout caught	% of nets that caught at least 1 lake trout
1992	**0.9 (0.4-1.4)**	**102 (30)**	**47**	**24%**
1993	**0.9 (0.6-1.3)**	**56 (90)**	**79**	**61%**
1997	**0.9 (0.5-1.3)**	**59 (30)**	**26**	**29%**

- The south basin of Buck Lake still supports a naturally self sustaining lake trout population with a density (number of lake trout per hectare of summer cold water habitat) that compares with Loughborough Lake. It should be noted that Loughborough Lake is only sustained at these levels through regular ongoing stocking
- A restricted amount of summer cold water lake trout habitat appears to limit the number of lake trout that can survive in the north basin. Refer to the discussion on this in the *Water Quality section for more details*

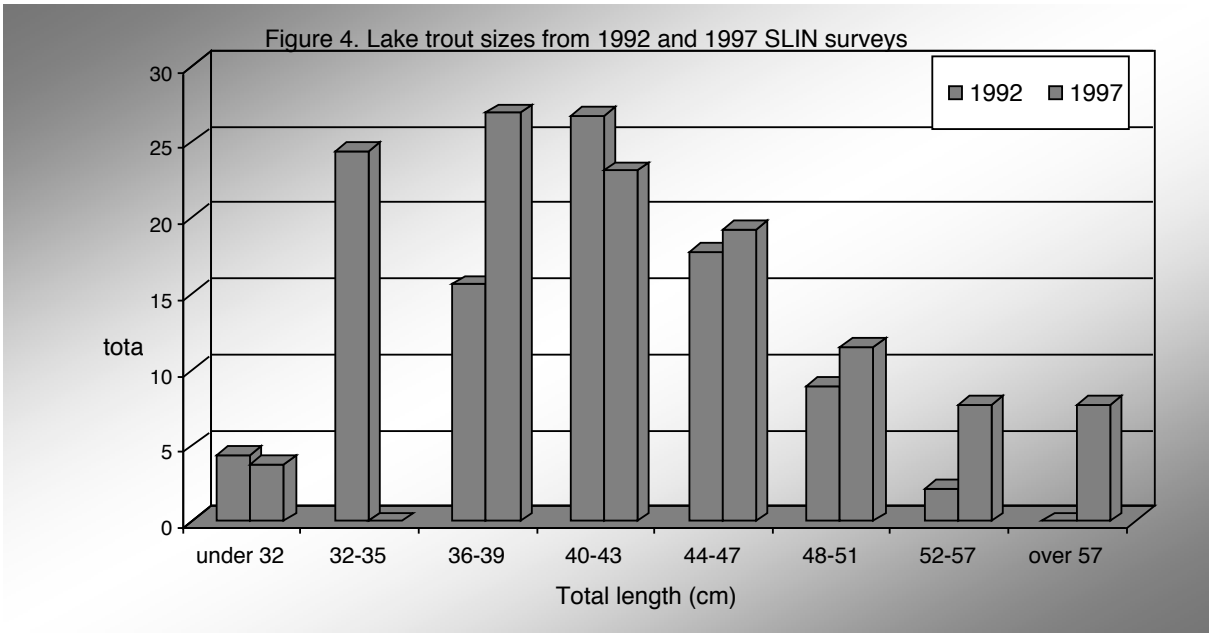
- Buck Lake contains an estimated density of 3.4 lake trout per hectare with a 95% confidence that the population size is between 465 and 2021 lake trout

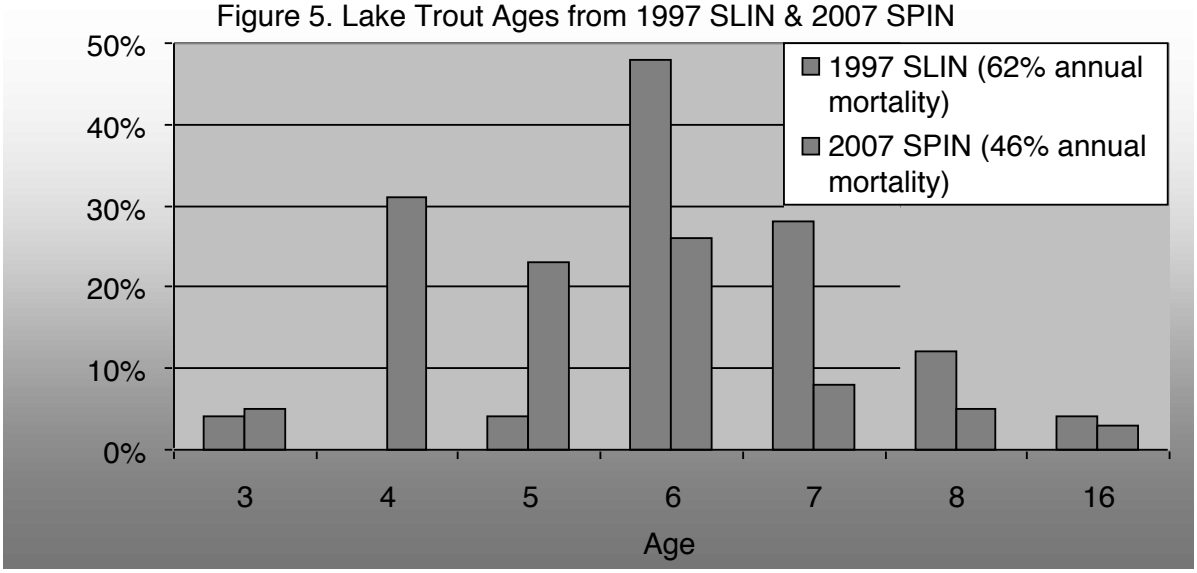
Table 5. Summer profundal index netting results from Buck Lake compared to surveys on other local lake trout lakes

Lake	SPIN Survey Year	No. Net Sets	Total Catch (no. fish)	Catch Per Net	Density (no. fish/ha)	Population Estimate	Lower Population Estimate	Upper Population Estimate
Buck	**2007**	**39**	**41**	**0.74**	**3.4**	**1233**	**465**	**2021**

Desert	2009	27	67	2.34	43.9	10527	8028	13199
Crow	2009	28	27	1.16	5.1	1432	805	2083
Big Salmon	2007	30	46	1.58	6.8	629	410	858
Little Clear	2007	27	3	0.19	1.1	89	0	236
Loughboroug	2006	28	24	0.79	3.6	1,524	0	3,237
h	2008	48	1	0.06	0.6	627	0	2,557
Bobs								

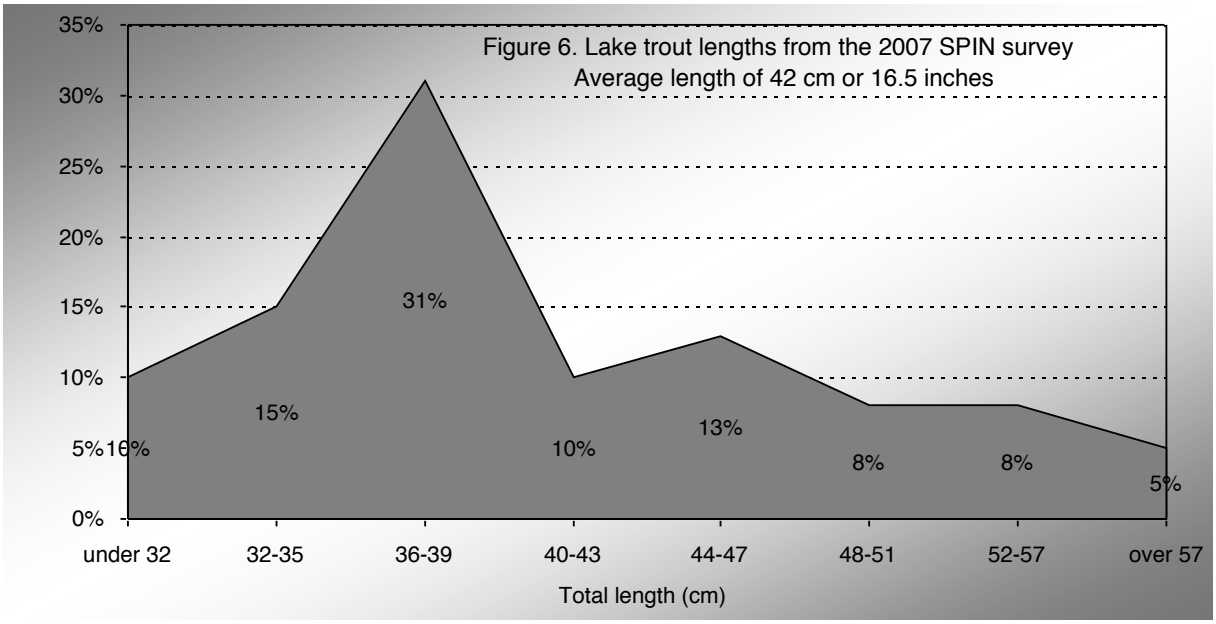
- Lake trout in Buck Lake began the process of adjusting the way they sustained their population during the 1990's through natural reproduction versus stocking
- Figure 4 and 5 shows that there were very few fish smaller than 36 cm in 1997 and that the majority (73%) are age-6 and age-7
- 28% of the lake trout captured in 1992 were naturally reproduced fish and 33% of those captured in 1997 were naturally reproduced, the remainder in each year were stocked fish





- The lake trout population in Buck Lake now appears to be stabilizing with no gaps in lengths and a good distribution of age-3 to age-8 fish, see Figures 5 and 6
- Annual mortality of lake trout was higher in 1997 (62%) than in 2007 (46%)
- The average length of lake trout caught in 2007 was 42 cm (16.5 inches) and weighed 0.8 kg (1.7

lbs)



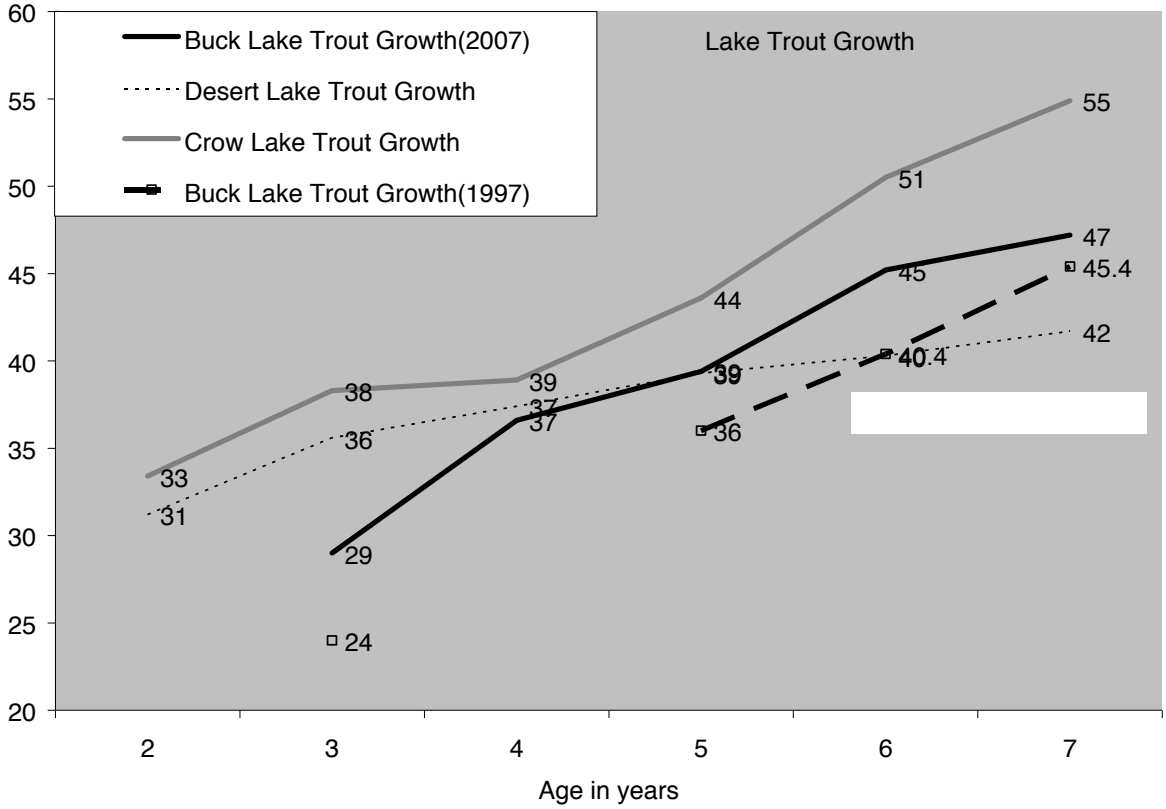
- Lake trout are growing faster now (2007) than they were 10 years earlier in 1997
- Growth is equated to the length of a particular fish at a given age. Figure 7 compares the average length at specific ages from lake trout caught on Buck, Crow and Desert Lakes
- This faster growth in recent years could be indicative of a population that has stabilized with its forage base. For example, if artificial recruitment (stocking) was higher than the lakes forage base (food items) could handle then their growth may have been slower
- Buck lake trout grow at slower rates than those from Crow Lake and those older than age-5 on Buck Lake grow faster than Desert lake trout

Table 6. Lake trout data from various local lake trout lakes.

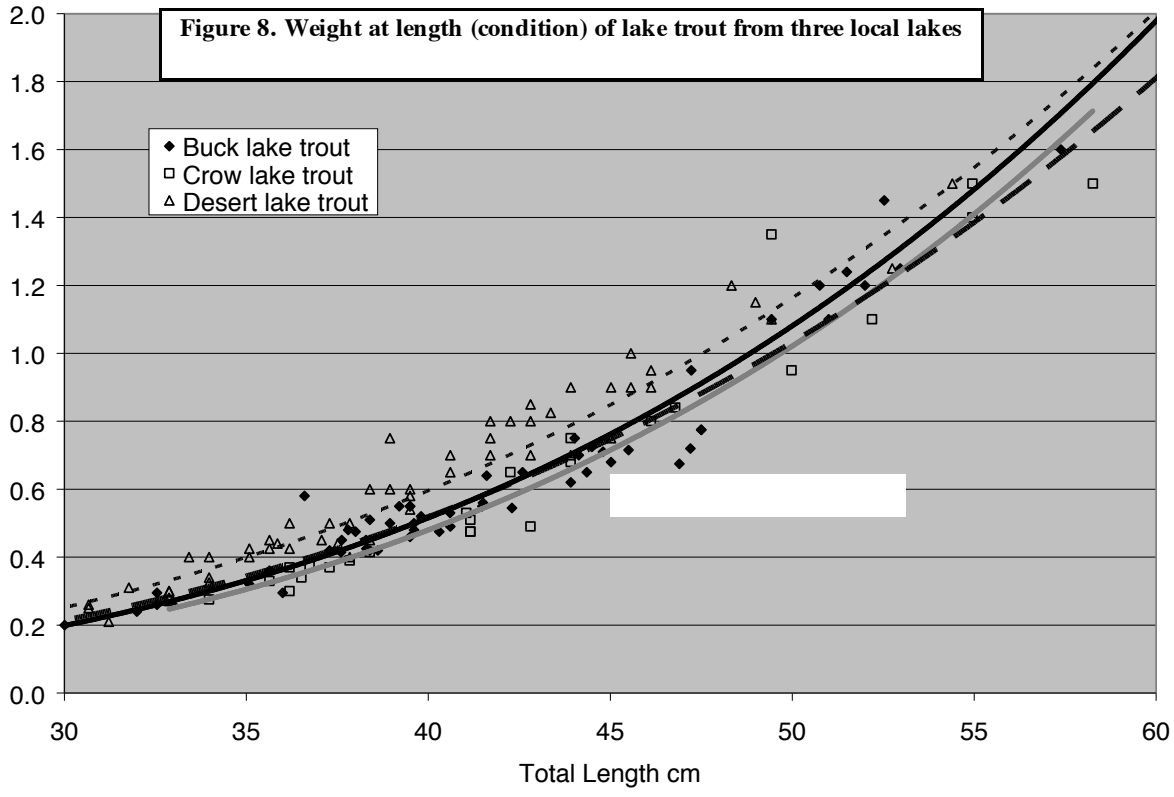
Lake	Number of lake trout per net-hour	Annual mortality	Average age	Average length	Average weight
Buck 2007	**0.5**	**46%**	**5**	**42 cm**	**0.7 kg**
Buck 1997	**0.9**	**62%**	**7**	**44 cm**	**0.9 kg**
Desert	**1.2**	**44%**	**5**	**40 cm**	**0.6 kg**
Crow	**0.5**	**43%**	**5**	**43 cm**	**0.7 kg**
Loughborough	**0.4**	**NA**	**NA**	**44 cm**	**1.1 kg**
Birch	**0.1**	**NA**	**12**	**46 cm**	**0.9 kg**
Eagle	**0.02**	**NA**	**17**	**72 cm**	**3.9 kg**
Sharbot	**0.02**	**NA**	**10**	**54 cm**	**1.3 kg**

Note: NA denotes that no data are available and/or not enough lake trout caught to calculate an estimate.

Figure 7. Growth rates of lake trout from Buck Lake in 1997 and 2007



- Comparisons of weight at specific lengths for individual lake trout sampled during each of the three survey years show their condition does not appear to have changed significantly since 1992. This measure can be used to describe what condition a fish population is relative to another
- There does not appear to be a significant difference in the condition of Buck lake trout to those in either Crow or Desert Lakes

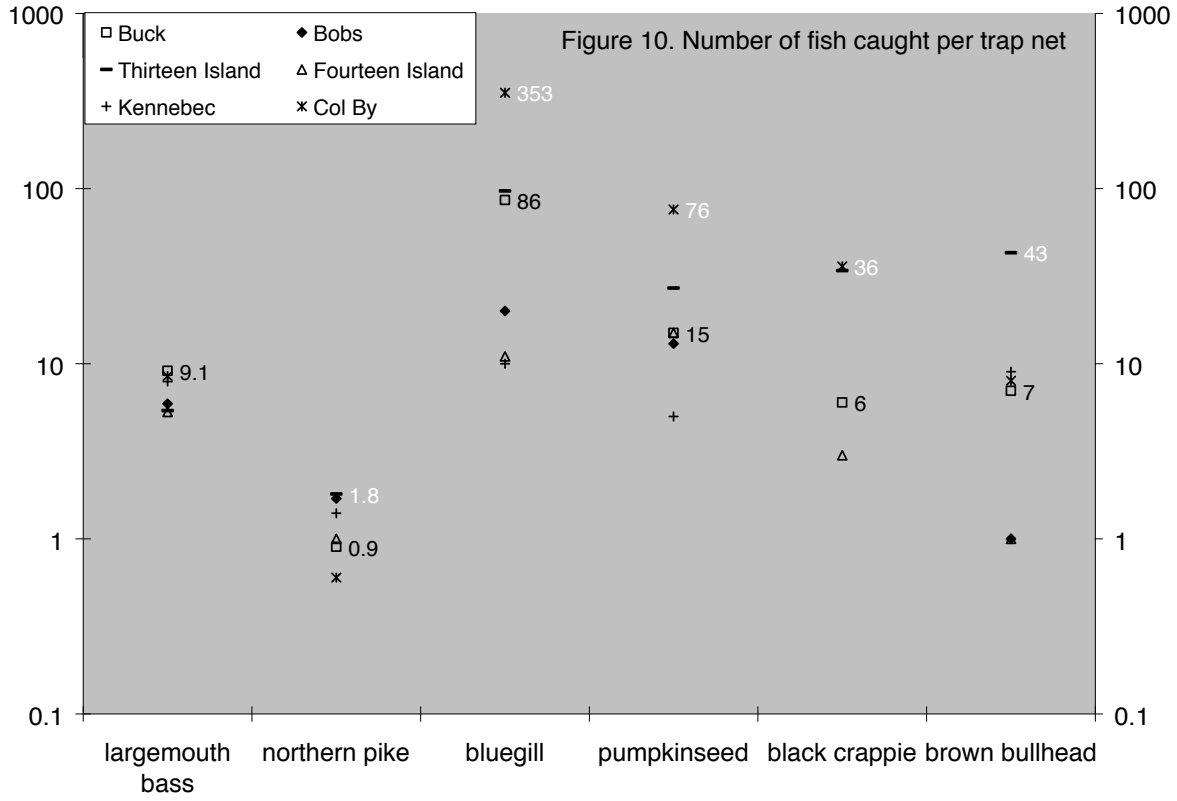


Smallmouth Bass & Yellow Perch

These two species are present in Buck Lake but will not be reported on in this report due to a lack of data. Neither of these species is vulnerable to the types of netting surveys carried out on Buck Lake. Angler surveys from 1978 suggest that both of these species are commonly harvested by anglers at numbers comparable or higher than other species reported upon here

Largemouth Bass Status

- Largemouth bass are the third most plentiful (7% of total catch) fish species located in the near shore area (46 meters from shore at depths less than 3.5 meters) of Buck Lake during the summer period (see figure 3)
- the average length of Buck Lake largemouth bass is 27 cm or 11 inches with only 29% larger than 12 inches and only 6% larger than 35 cm or 14 inches
- there are higher numbers of largemouth bass in Buck Lake versus other surveyed area lakes but there are fewer fish longer than 12 and 14 inches (see table) or the size at which most anglers would keep
- Buck Lake largemouth bass grow slower than any of the other area lakes surveyed (see figure)
- The predicted growth rates shown in figure below can be used to estimate how old a largemouth bass is based upon it's total length
- The mean age of Buck Lake largemouth bass is age-4



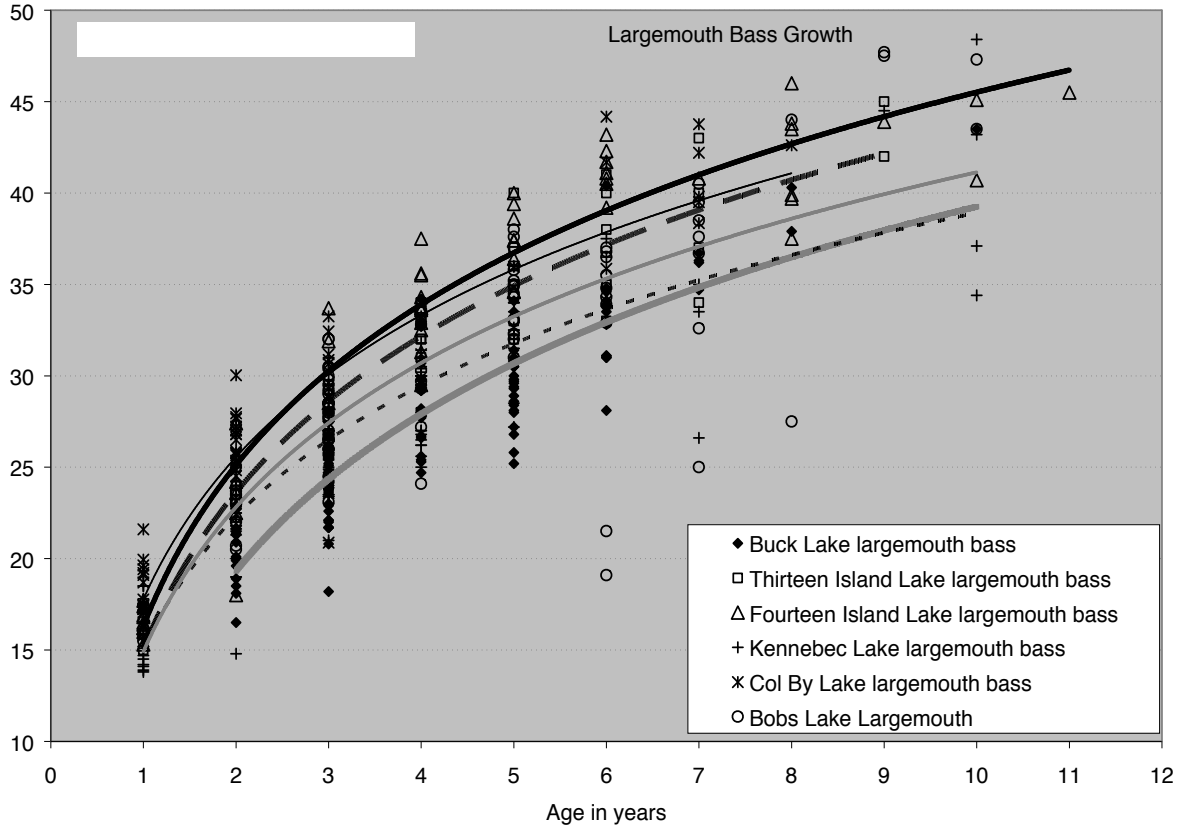
Note: ***Italic bold numbers*** represent the number of fish per trap net caught on Buck Lake and white numbers represent the lake with the highest number per trap net of each fish species

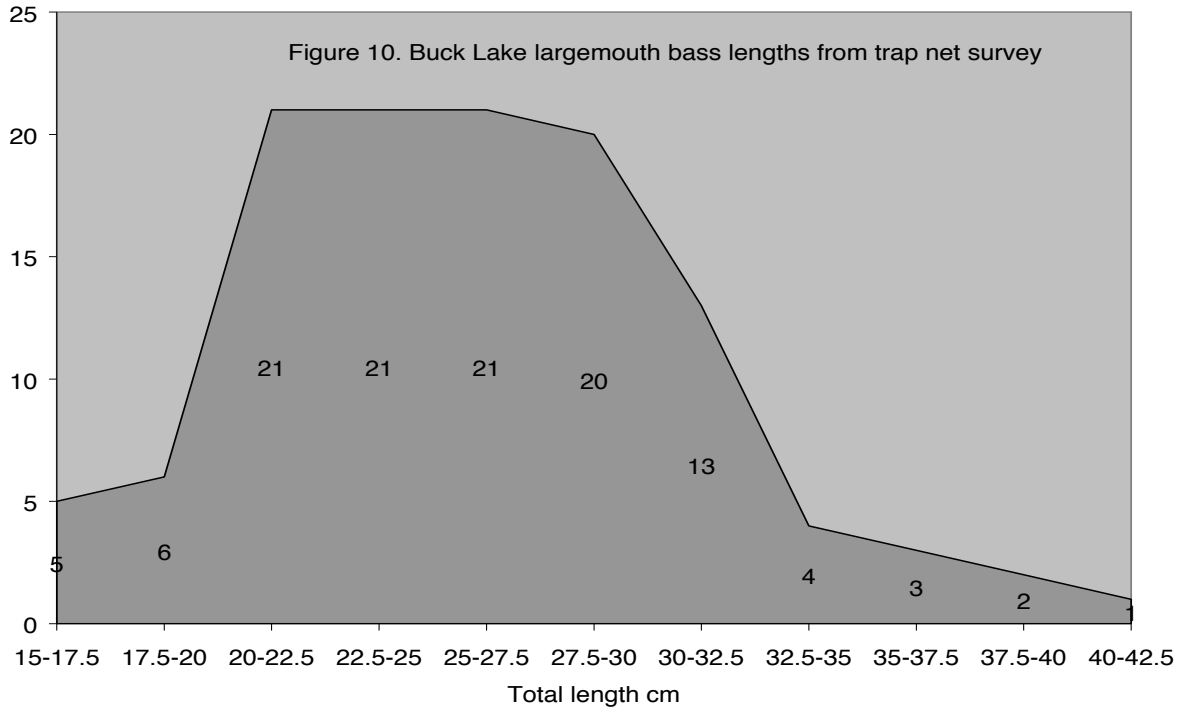
Table 7. Information about largemouth bass in Buck Lake versus other area lakes

Lake	Average number per net	% of total catch	Annual Mortality	Average length	Average weight	% of catch longer than 12 inches	% of catch longer than 14 inches

Buck	**9**	**7**	**47%**	**27cm; 11in**	**0.3kg; 0.7lbs**	**29%**	**6%**
Bobs	6	13	42%	32cm; 13in	0.6kg; 1.3lbs	57%	28%
Thirteen Island	5	3	48%	33cm; 13in	0.6kg; 1.3lbs	74%	38%
Fourteen Island	5	13	40%	33cm; 13in	0.8kg; 1.8lbs	71%	50%
Kennebec	8	20	53%	27cm; 11in	0.3kg; 0.7lbs	36%	8%
Col By	8	2	NA	27cm; 11in	0.4kg; 0.9lbs	31%	15%

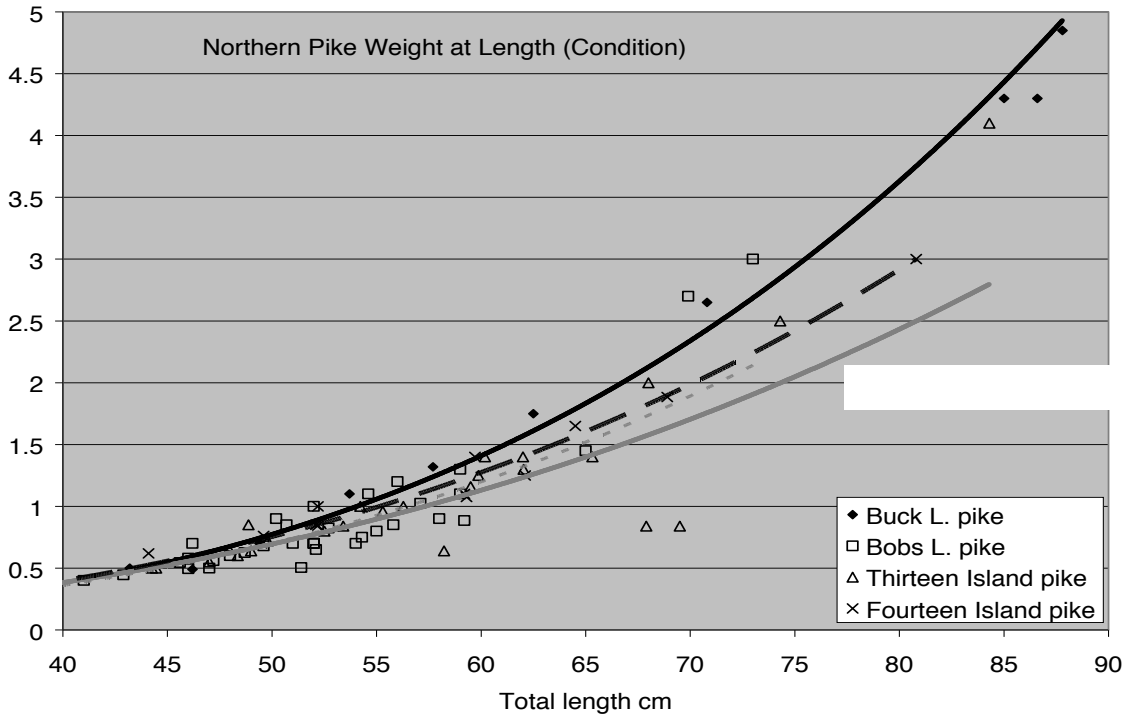
Figure 10. Largemouth bass growth rates in Buck Lake versus other surveyed area lakes (each symbol represents an individual fish)

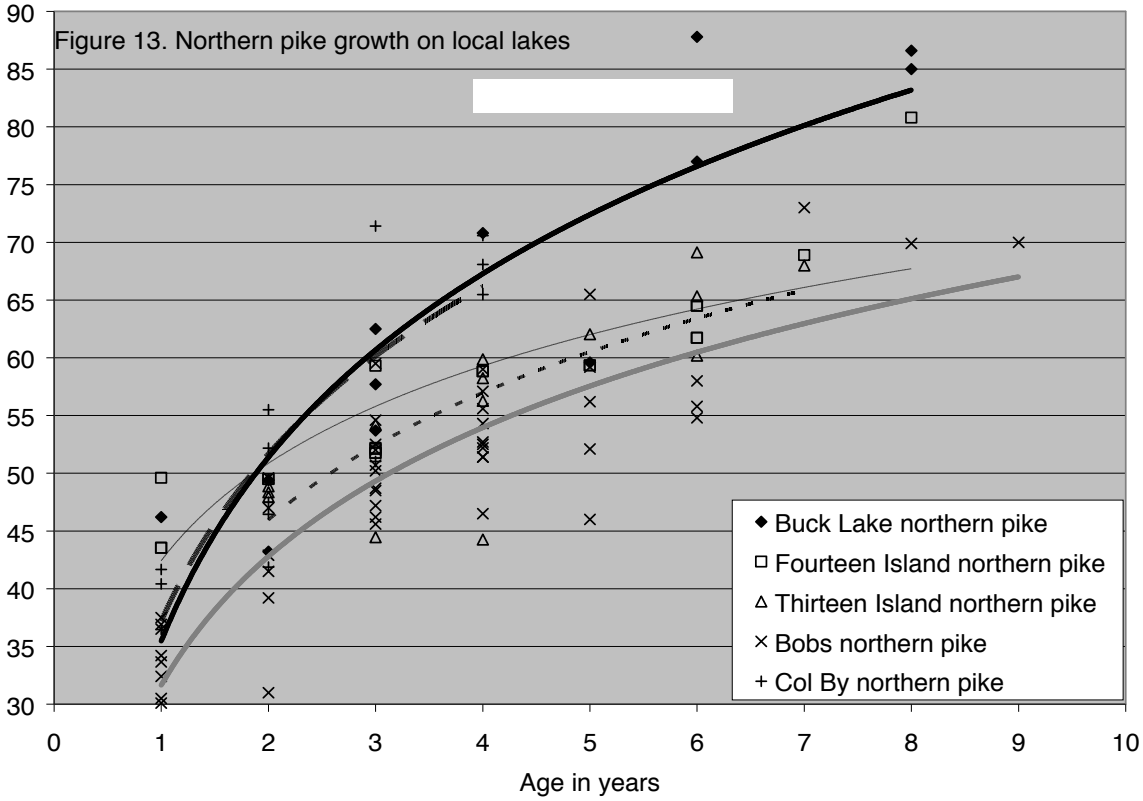




Northern Pike Status

Figure 11. Buck Lake northern pike weight at length (condition) compared with other local lakes





Note: each symbol represents an individual northern pike sampled from net surveys

- Northern pike from Buck Lake appear to be in better condition and grow significantly faster than those from a other local lakes with information(Figure 11)

Panfish Status

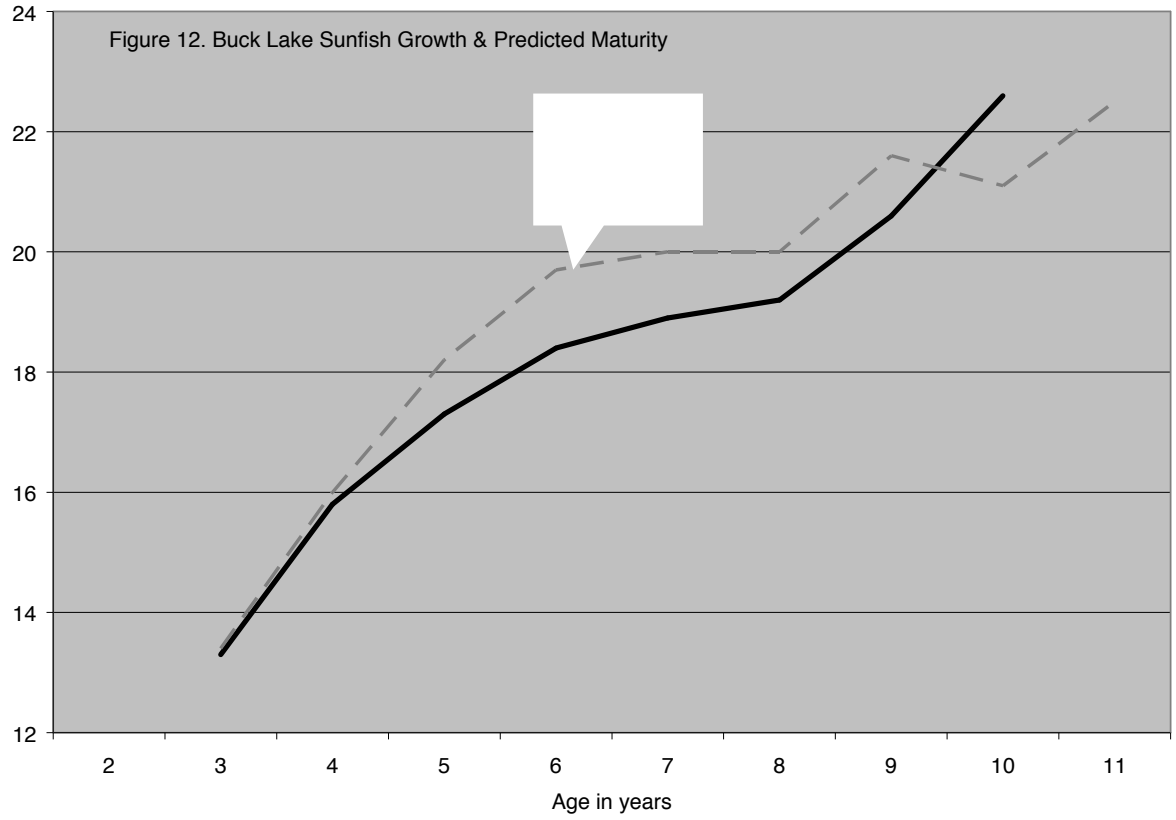
- For the purposes of this report, panfish refer to the following fish species: bluegill & pumpkinseed (sunfish); black crappie; rock bass and; brown & yellow bullhead

Table 8. Panfish data from various local lakes

Fish Species	Measurement	Buck L.	**Bobs L.**	**Thirteen Island L.**	**Fourteen Island L.**	**Kennebec L.**	**Col By L.**
Bluegill	**No. per net** **% of catch** **Mean length** **% 18 cm+** **Mortality**	**86 fish** **68%** **17 cm** **43%** **46%**	20 fish 44% 18 cm 54% 48%	97 fish 45% 20 cm 76% NA	11 fish 27% 14 cm 1% NA	10 fish 15% 17 cm 35% 44%	353 fish 71% 15 cm 5% 72%
Pumpkinseed	**No. per net** **% of catch** **Mean length** **% 18 cm+** **Mortality**	**15 fish** **12%** **20 cm** **82%** **31%**	13 fish 28% 19 cm 71% 61%	27 fish 13% 20 cm 78% NA	15 fish 37% 17 cm 42% NA	5 fish 7% 18 cm 63% 46%	76 fish 15% 16 cm 12% 55%
Sunfish (bluegill & pumpkinseed)	**No. per net** **% of catch** **Mean Length** **% 18 cm+**	**101 fish** **80%** **18 cm** **56%**	34 fish 72% 18 60%	124 fish 58% 20 cm 77%	26 fish 64% 16 cm 28%	15 fish 22% 18 cm 44%	429 fish 86% 15 cm 7%
Black Crappie	**No. per net** **% of catch** **Mean length** **% 22 cm+** **Mortality**	**6 fish** **5%** **20 cm** **32%** **58%**	only 1 fish caught total in 2008	34 fish 15% 22 cm 49% 56%	3 fish 8% 28 cm 97% 63%	none caught in 2009	36 fish 7% 21 cm 51% 93%

Rock Bass	**No. per net** **% of catch** **Mean length** **% 20 cm+**	**1 fish** **1%** **13 cm** **20%**	3 fish 6% 22 cm 56%	1 fish 1% 20 cm 82%	2 fish 5% 19 cm 33%	1 fish 1% 19 cm 25%	4 fish 1% 18 cm 27%
Brown Bullhead	**No. per net** **% of catch** **Mean length** **% 30 cm+**	**7 fish** **5%** **31 cm** **60%**	1 fish 3% 29 cm 53%	43 fish 20% 31 cm 65%	1 fish 3% 31 cm 74%	9 fish 14% 28 cm 19%	8 fish 2% 28 cm 43%
Yellow Bullhead	**No. per net** **% of catch** **Mean length** **% 30 cm+**	**1 fish** **1%** **26 cm** **14%**	total of 2 fish caught in 2008	total of 3 fish caught in 2007	1 fish 2% 31 cm 83%	1 fish 1% 26 cm 11%	3 fish 1% 25 cm 4%

Note: % larger than a certain length per species is based upon a length that most anglers might first consider keeping. Mortality is an estimate of total annual mortality.



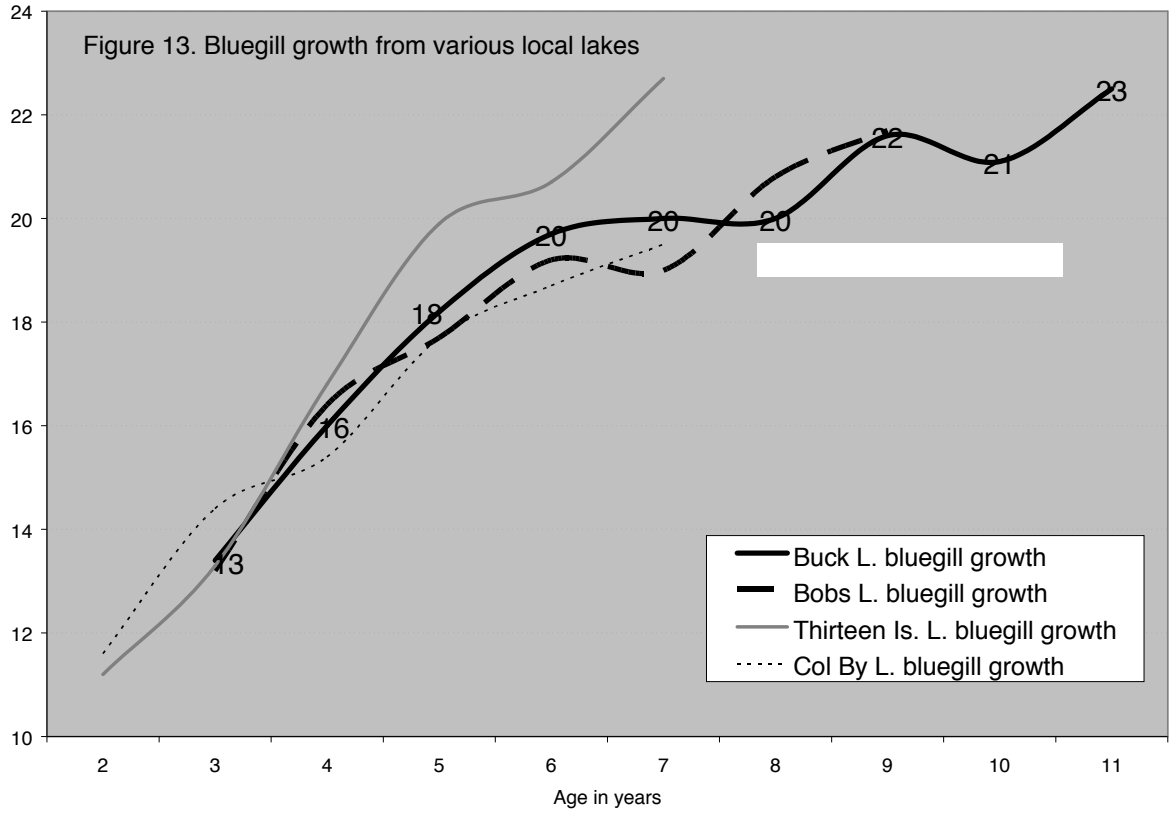


Figure 13. Bluegill growth from various local lakes
24
22
20
18
16
14
12
10
2
3
4
5
6
7
8
9
10
11
Age in years
13
16
18
20
20
20
22
21
23
Buck L. bluegill growth
Bobs L. bluegill growth
Thirteen Is. L. bluegill growth
Col By L. bluegill growth

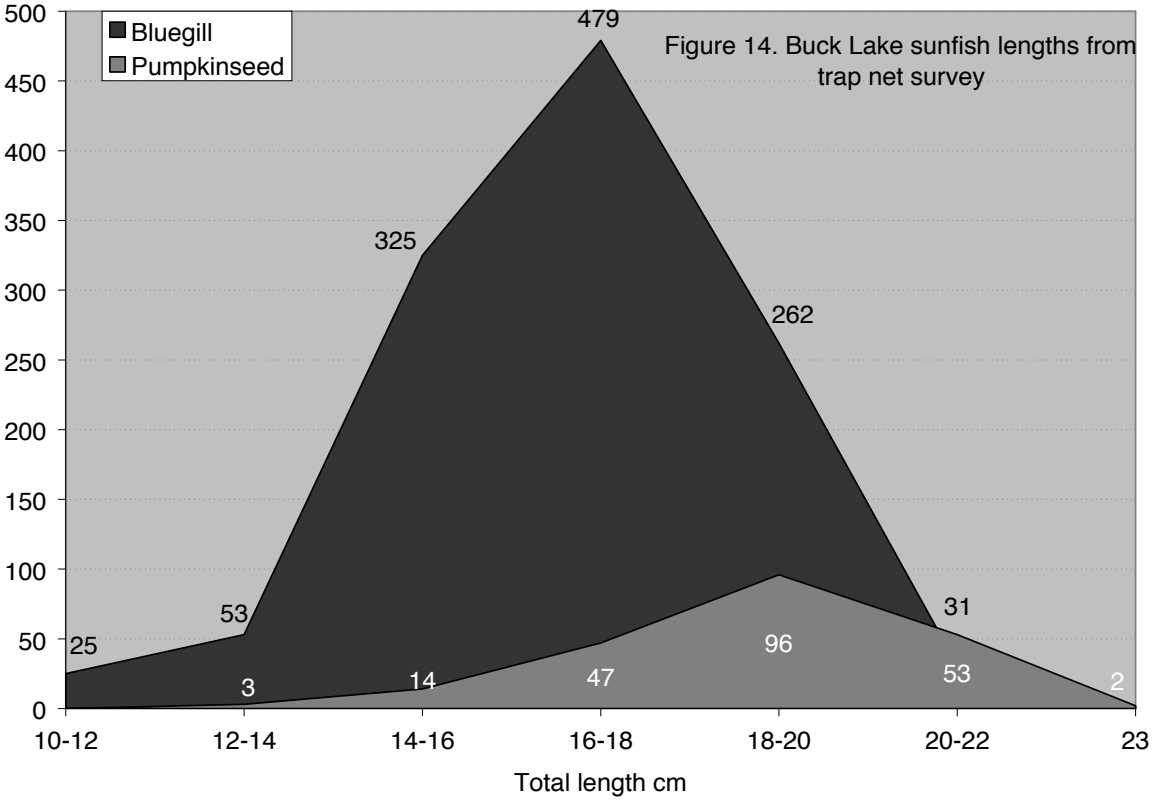
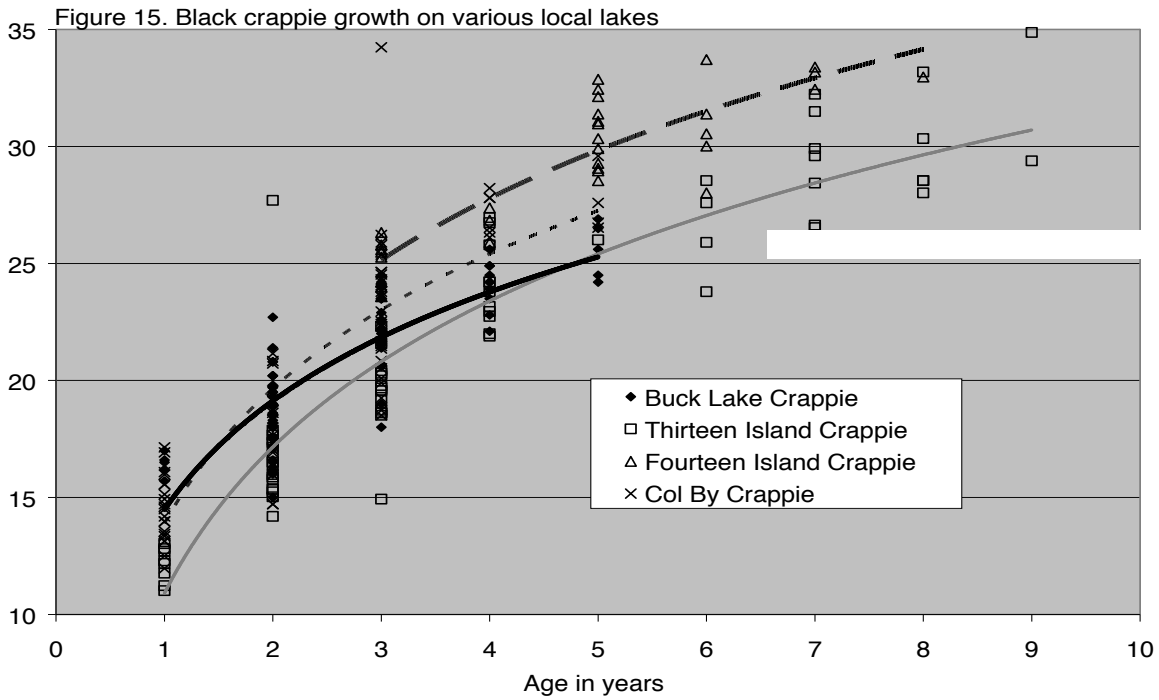
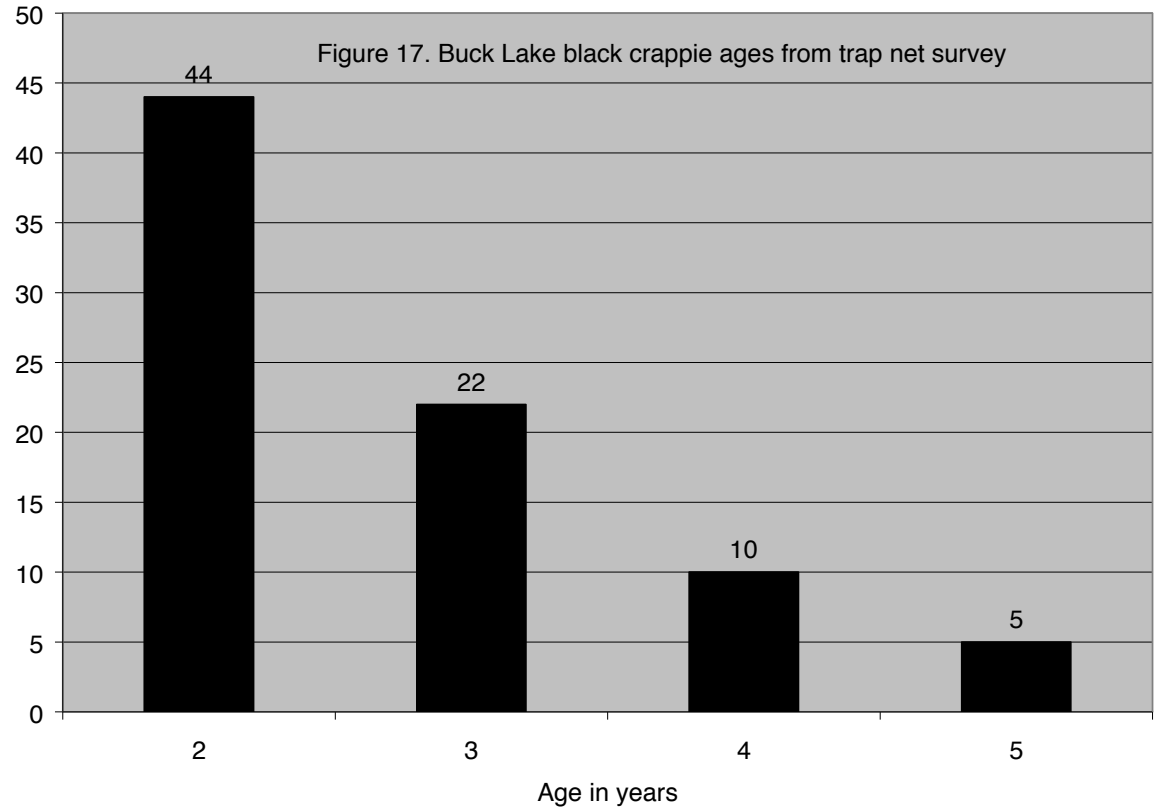
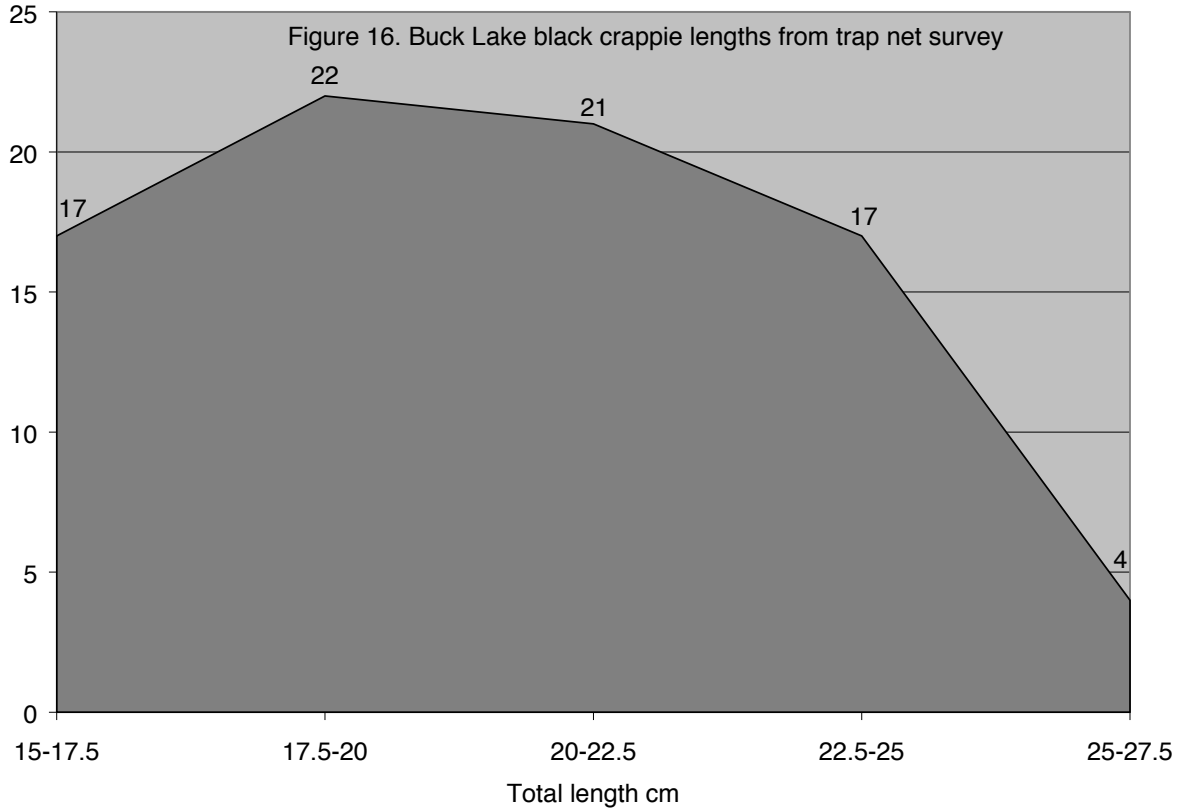


Figure 14. Buck Lake sunfish lengths from trap net survey
Bluegill
Pumpkinseed
500
450
400
350
300
250
200
150
100
50
0
10-12
12-14
14-16
16-18
18-20
20-22
23
Total length cm
25
53
325
479
262
31
2
3
14
47
96
53



Note: symbols represent individual black crappie with different symbols for each lake; trend line represents an estimate growth rate based upon the individual fish measurements; also only four age groups found on Buck Lake with none older than age-5, indicative of substantial fishing mortality [pressure] on older fish longer than 25 cm (10 in)





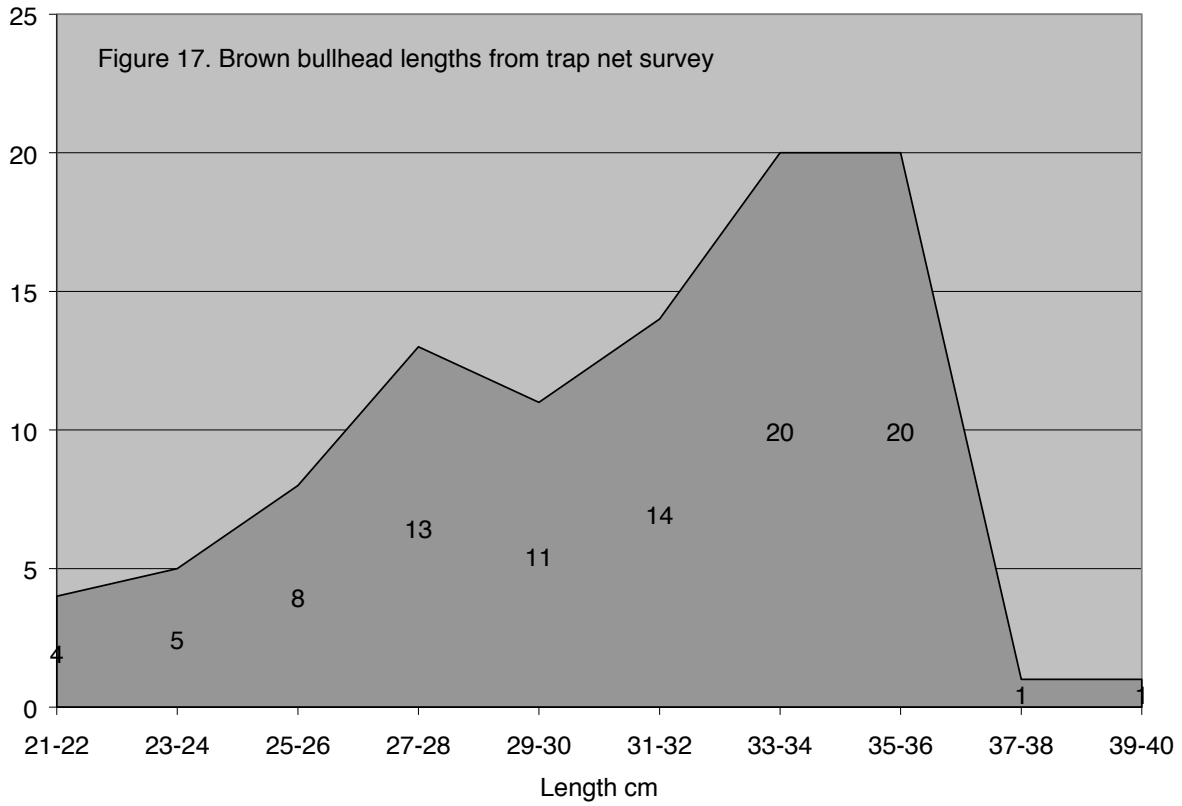
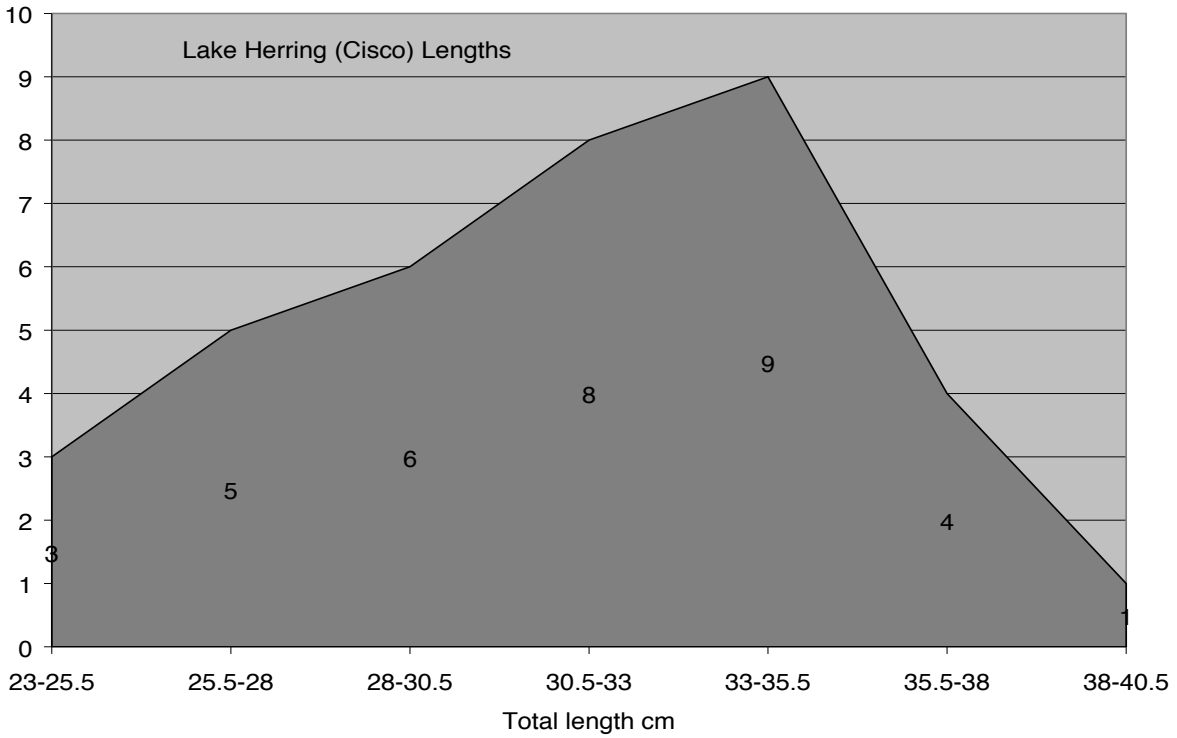


Figure 18. Lake herring (cisco) lengths from gill net survey



Water Quality

Temperature & Oxygen

The most critical water quality conditions for lake trout develop during late summer. At this time of the year, water temperatures and dissolved oxygen conditions combine to restrict the portion of the lake containing suitable water quality for lake trout. Most lake trout lakes are temperature stratified from June through October.

Lakes warm from the surface (epilimnion) downward and lose oxygen from the bottom (hypolimnion) upward. This oxygen depletion in the deep waters is known as "hypolimnetic oxygen depletion". An adequate supply of dissolved oxygen is essential to meet metabolic demands and to carry out the daily life support activities of lake trout. Lake trout require water temperatures of 15.5°C or cooler and dissolved oxygen concentrations of 4 mgL^{-1} or greater for survival. The zone or habitat within a lake usable to lake trout can be delineated by the portion of the lake possessing water temperatures less 15.5°C and oxygen concentrations greater than 4 mgL^{-1}. Lake trout have been documented to move up into the warmer, shallower layers at night to feed but do so under extreme stress and can not remain at these temperatures for any extended period of time. The optimal, stress-free zone for lake trout possesses temperatures 10°C or cooler and dissolved oxygen concentrations of 6 mgL^{-1} or greater.

Existing information indicates that the threshold for growth impairment in six species of salmonids, including lake trout, is 7-8 mgL^{-1}. Smaller, younger lake trout (juveniles) are more sensitive than adults to oxygen depletion because they live at greater depths than adult lake trout. This allows them to avoid predation by adult lake trout but also restricts them to depths where dissolved oxygen concentrations are most depleted.

Experiments reveal that juvenile lake trout activity levels are at ¼, ½, and ¾ of their full potential when dissolved oxygen concentrations are at 4.4, 5.8 and 7.1 mgL^{-1}, respectively. An environment that provides 7 mgL^{-1} of dissolved oxygen should provide for most daily life-support activities of juvenile and adult lake trout.

Independent surveys of lake trout populations in four geographic areas of Ontario (Bancroft, Minden, Mazinaw, Bracebridge) revealed that natural recruitment of wild lake trout populations was good to excellent when the mean volume-weighted hypolimnetic dissolved oxygen concentration (MVWHDO)

was 7-8 mgL^{-1} in late summer. Recruitment was average to poor when MVWHDO was less than 6 mgL^{-1}. Recruitment is defined as young lake trout surviving to maturity so they can reproduce.

MVWHDO is a calculation of the mean dissolved oxygen concentrations that exist within the hypolimnion. These concentrations are weighted by the volume of each respective hypolimnetic layer thus giving a mean-volume weighted hypolimnetic dissolved oxygen concentration at a specific time frame in late summer.

Refer to **"Evans, D.O., 2005 Effects of hypoxia on scope-for-activity of lake trout: defining a new dissolved oxygen criterion for protection of lake trout habitat. Tech. Rep. 2005-01 Habitat and Fisheries Unit, ARDS, ARDB, Peterborough, 18 p."** for a more detailed explanation of MVWHDO.

The below tables show more recent oxygen and temperature data collected on Buck Lake with a delineation of lake trout usable (light grey) and optimal habitat (dark grey). Additionally, the MVWHDO has been calculated for each sampling episode.

Table 9. Late summer temperature and dissolved oxygen readings from the south & north basins in 2005, 2007 and 2008

Deepest hole in South Basin (Max depth=39.5m)							
	September 12th, 2005		September 26th, 2007		September 8th, 2008		
Depth(m)	Temp (C)	DO (mgL-1)	Temp(°C)	DO (mgL^{-1})	Temp(°C)	DO (mgL^{-1})	Depth(m)
1	21.3	10.06	20.09	9.47	23.0	8.5	1
2	21.3	10	20.04	9.46	23.0	8.6	2
3	21.3	9.95	20.02	9.45			3
4	21.3	10.24	20.00	9.44	22.8	8.5	4
5	21.3	10.14	19.94	9.43	22.8	8.5	5
6	21.3	10.18	19.91	9.43	22.8	8.4	6
7	21.3	9.72	19.87	9.43	22.8	8.4	7
8	19.7	10.44	19.45	9.49	17.5	10.4	8
9	14.9	11.78	17.65	9.88	12.0	11.0	9
10	11.2	11.8	11.81	11.35	10.0	9.8	10
11	9.7	10.23	8.83	9.85	8.8	9.5	11
12	8.9	9.04	8.17	9.08	8.0	7.8	12
13	8.1	7.73	7.03	6.18	7.8	7.2	13
14	7.6	6.56	6.83	6.16	7.6	6.2	14
15	7.3	6.2	6.67	5.39			15
16	7.1	5.44	6.57	5.13	7.4	5.8	16
18	6.9	5.17	6.38	5.07	7.0	5.6	18
20	6.8	5.41	6.21	4.98	7.0	5.6	20
22	6.6	5.43	6.13	4.92	7.0	5.4	22
24	6.4	5.58	6.07	4.87	7.0	5.2	24
26	5.9	5.19	6.05	4.85	6.8	4.6	26
28	5.3	4.46	5.91	4.69	6.4	4.6	28
30	5.0	2.37	5.85	4.56	6.0	3.5	30
32	4.7	0.23	5.83	4.56	6.0	2.3	32
34			5.77	4.51	6.0	1.7	34
36					6.0	1.5	36
38							38

Note: light gray shading indicates the depths with usable lake trout habitat and dark gray shading indicates the depths with optimum lake trout habitat

Also, the mean volume-weighted hypolimnion dissolved oxygen (MVWHDO) concentrations or average concentration of dissolved oxygen below the thermocline is shown for each year below:

	Sept 12, 2005	Sept 26, 2007	Sept 8, 2008
MVWHDO:	**6.19**	**5.91**	**6.44**

Deep hole in North basin (max. depth=29.5m)

	September 12th, 2005		September 6th, 2007		September 8th, 2008		
Depth (m)	**Temp. (C)**	**DO (mgL-1)**	**Temp (°C)**	**DO (mgL^{-1})**	**Temp (°C)**	**DO (mgL^{-1})**	**Depth (m)**
1	21.5	10.49	22	9.06			**1**
2	21.3	10.49	22	9.06	23.0	8.7	**2**
3	21.3	10.25	21.9	9.08			**3**
4	21.3	10.49	21.9	9.15	23.0	8.7	**4**
5	21.2	10.49	21.7	9.11			**5**
6	21.2	10.43	21.6	9.04	23.0	8.7	**6**
7	21.1	10.31	21.5	8.77	23.0	8.7	**7**
8	20.6	9.47	18.4	9.46	23.0	8.5	**8**
9	16.8	9.35	14.2	9.95	18.4	8.7	**9**
10	12.3	8.01	10.6	9.43	17.5	8.2	**10**
11	10.6	6.41	9	8.44	15.8	8.6	**11**
12	9.4	5.11	8.4	7.73	9.2	6.2	**12**
13	8.6	4.06	7.2	6.19	9.0	6.9	**13**
14	8.2	3.45	6.7	5.24	7.5	4.9	**14**
15	7.6	2.36	6.4	4.5			**15**
16	7.3	1.65	6.4	4.45	7.2	4.3	**16**
18	7.2	1.53	6.2	3.78	7.0	3.8	**18**
20	7.1	1.29	6	3.51	7.0	3.7	**20**
22	6.9	1.07	6	2.93	7.0	3.4	**22**
24	6.6	0.99	5.9	2.88	7.0	3.1	**24**
26	6.2	0	5.8	1.76	7.0	2.8	**26**
28			5.7	0.86	7.0	1.6	**28**
30							**30**

MVWHDO:

Sept 12, 2005	Sept 6, 2007	Sept 8, 2008
2.33	**4.75**	**4.73**

These charts illustrate that late summer habitat is much more favourable to Lake Trout in the South Basin than in the North Basin.

A secchi disc is a simple instrument used to measure water clarity. The disc is lowered slowly into the water and the depth at which it is no longer visible is recorded. A high secchi reading (greater depth) means that the water is clearer than a low secchi reading (shallower depth).

Phosphorus is a nutrient that is present in lakes. Its concentrations reflect the general nutrient status of a particular lake. Increases in phosphorus can lead to increased algae growth. This can in turn decrease water clarity and have effects on the lake ecosystem.

Since 1996, data on Secchi depth and total phosphorus (TP) has been recorded by the Buck Lake Association through Ontario's Lake Partner Program. These data have been summarized in figures 19 to 23. Figure 19 suggests that lake-wide total phosphorus concentrations show a trend of slightly increasing

from 1996 to 2004 but have since decreased to concentrations similar to those recorded in 1996. Monthly TP samples have been taken since 2002. These have been divided into spring (March through May) and summer (June through August) seasonal categories and summarized in Figure 20. **Figure 19. Annual lake-wide total phosphorus concentrations from Buck Lake as collected through the Ontario's Lake Partner Program with a trend line added**

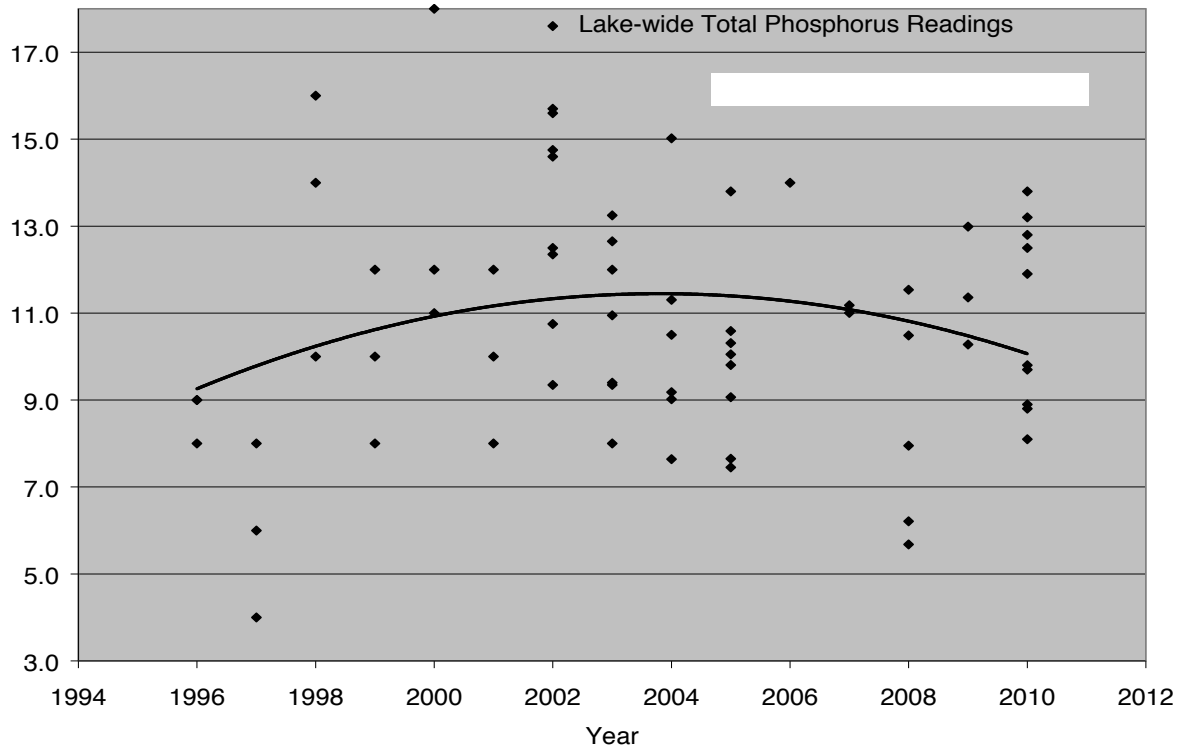
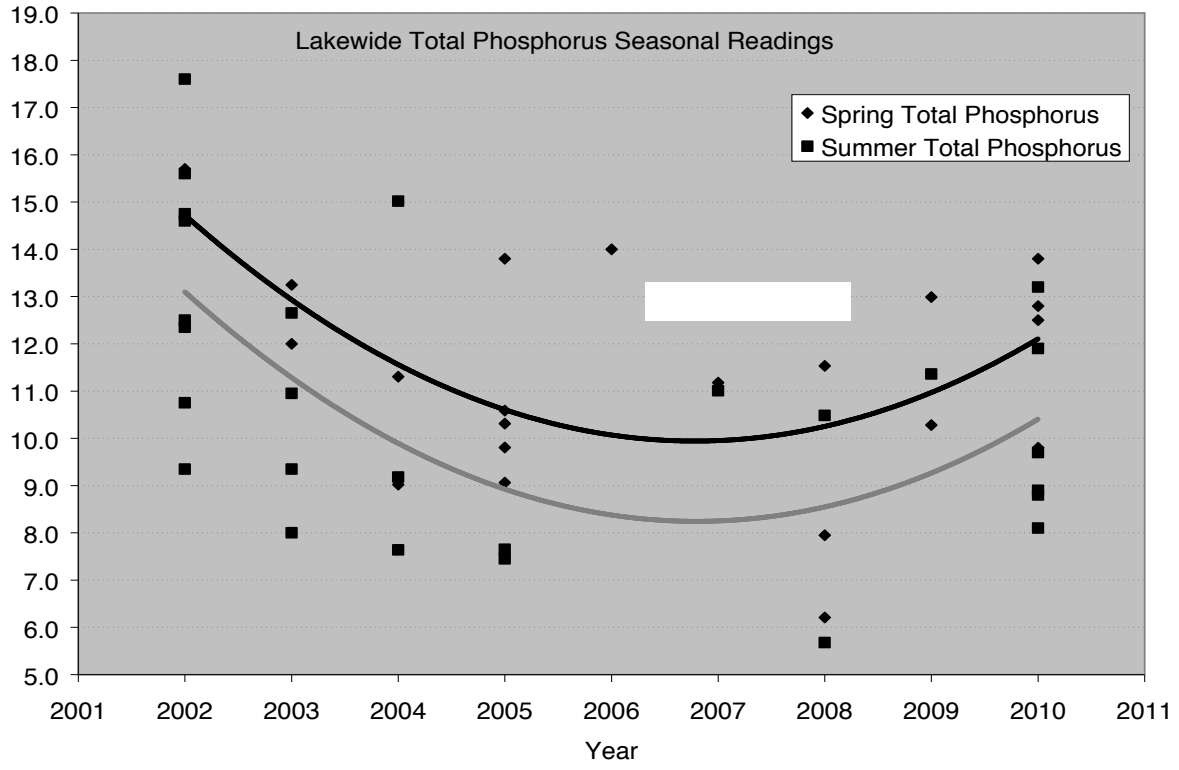


Figure 20. Individual lake-wide total phosphorus concentration readings from Buck Lake summarized by spring (March-May) and summer (June-August) with trend lines added



These readings suggest that both spring and summer TP concentrations decreased until 2007 with increases noted in recent years. Figure 21 further summarizes individual TP concentrations by season and basin from water samples taken since 2002. A line has been added to illustrate trends occurring over this period of time. The first trend noticed is that TP concentrations have been higher in the North basin

versus the South basin but are more recently approaching similar concentrations due to an increasing trend in South basin readings.

Figure 21. Individual total phosphorus concentration readings from Buck Lake summarized by season and by basin with a trend lines added

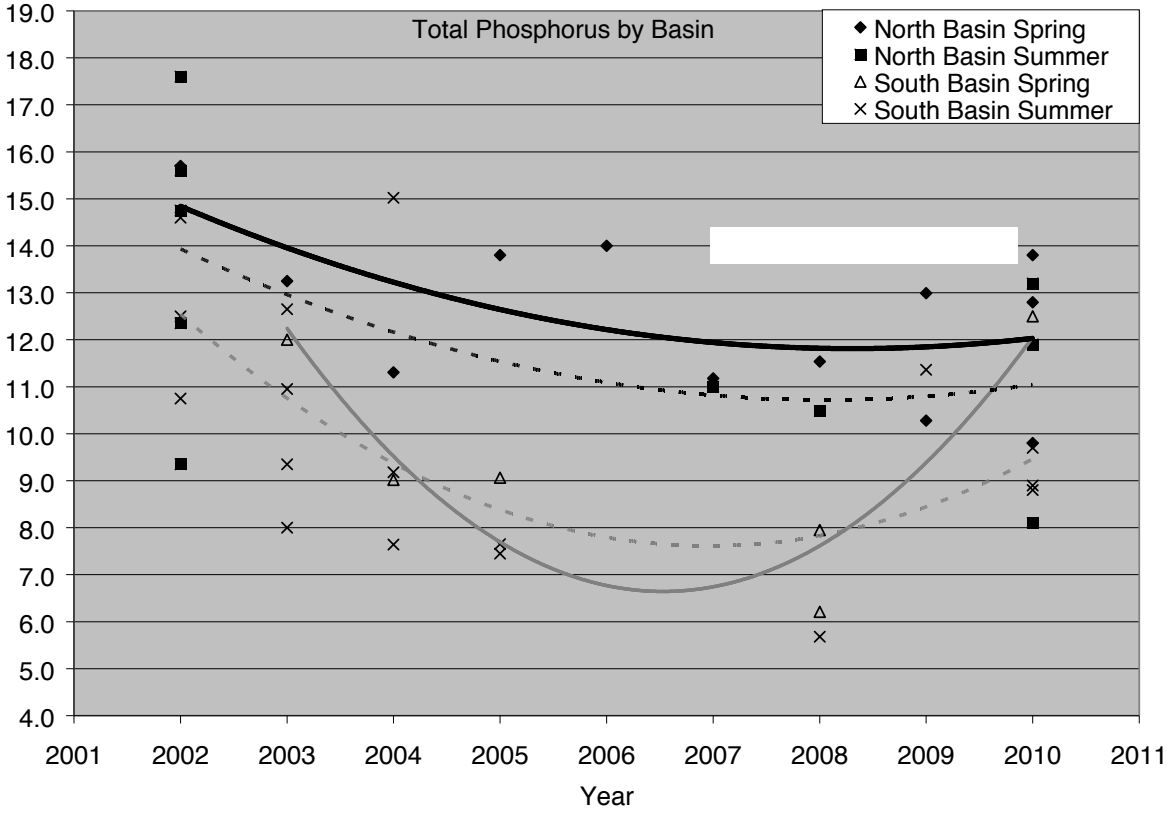


Figure 22 indicates that lake-wide Secchi depths have become two (2) meters shallower since 1996 thus clarity has decreased. This might suggest a similar increase in total phosphorus but the above noted summary does not support this relationship. Historical Secchi depth readings were analyzed versus total phosphorus concentrations and there was no significant relationship observed between the two readings. For example, decreasing Secchi depths could not be explained by total phosphorus concentrations. This might suggest that decreases in Secchi depth are being caused by some other variable. Figure 23 summarizes Secchi depth readings by two different locations within each of the North and South basins. A similar decrease in clarity is noted at three of these locations; however, the clarity in the south arm of the south basin is similar now to a reading obtained in 2000. It should be noted that no readings were obtained from this particular location for the years 2001-2007 so it is uncertain what occurred during this period.

Figure 22. Individual lake-wide Secchi depth readings from Buck Lake as collected through Ontario's Lake Partner Program with a trend line added

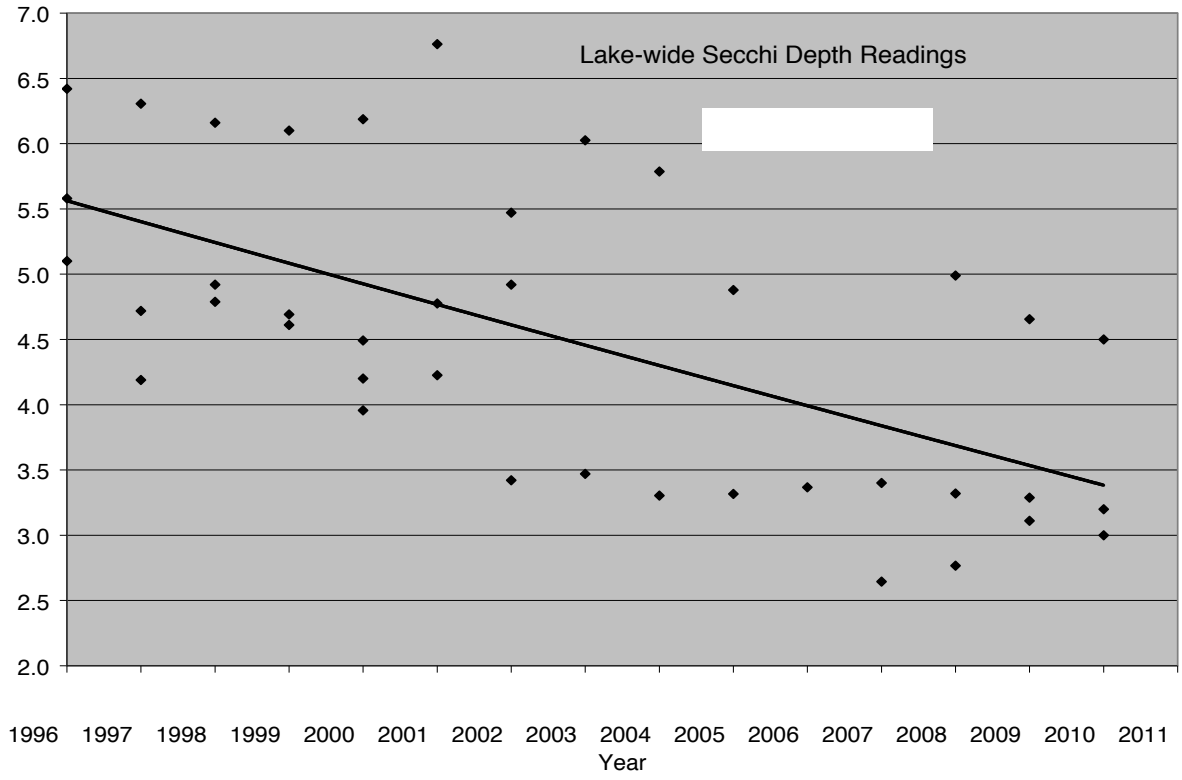


Figure 23. Individual Secchi depth readings from four (4) different locations on Buck Lake with trend lines added for each location

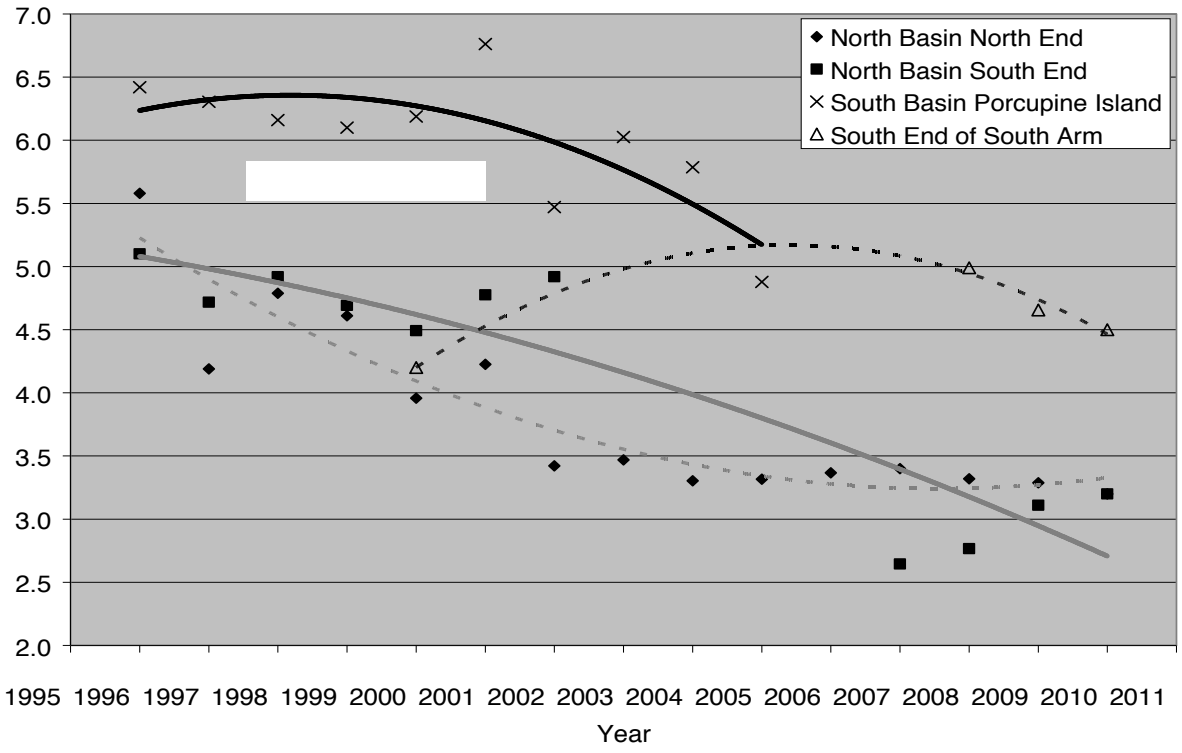


Table 10. Fish Species Report Card

Fish Species	Indicator/Benchmark	Comments
lake trout	**Density**	**Medium density compared with other local lake trout lakes**
	Number fish per net-hour	**Medium numbers compared with other local lake trout lakes**
	Lengths	**Good size distribution; mean length similar to other sustainable local lake trout lakes**

	Ages	**Good age distribution from age-3 to age-8; mean age similar to other sustainable local lake trout lakes; annual mortality lower than 10 years ago and now similar to other sustainable local lake trout lakes**
	Growth	**Average compared to other local lake trout lakes**
	South Basin Late Summer Habitat	**Average to poor recruitment to the fishery in some years due reduced dissolved oxygen concentrations in the hypolimnion**
	North Basin Late Summer Habitat	**Very little recruitment to the fishery occurs in North Basin due to low dissolved oxygen in hypolimnion**
Largemouth bass	**Relative abundance**	**Second most abundant species behind sunfish but medium abundance compared with other local lakes**
	Number fish per net	**High abundance compared with other local lakes**
	Lengths	**Small mean length; fewest % of keeper fish compared with other local lakes**
	Ages	**Good age distribution from age-2 to age-6 with few fish age-7 or older which might indicate high fishing pressure on these older fish; average annual mortality compared with other local lakes**
	Growth	**Slowest growing fish compared with five (5) other local lakes**
Northern pike	**Number fish per net & relative abundance**	**Low abundance and low numbers but similar to all other local lakes sampled**
	Growth & Condition	**Significantly faster growth and better condition than other local lakes sampled for fish larger than 70 cm and older than age-4**

Note: Green shading indicates low concern with this indicator at this time; orange shading indicates medium concern with this indicator and; red shading indicates high concern.

Fish Species	Indicator/Benchmark	Comments
Bluegill	**Relative abundance**	**High abundance compared to other species in Buck Lake; medium abundance compared to other local lakes sampled**
	Number of fish per net	**High number compared with other species in Buck Lake; medium number compared to other local lakes**
	Lengths	**Mean length is slightly smaller than what angler will keep; medium abundance of fish anglers will keep**
	Ages	**Good distribution of fish from age-3 to age-9; poor year-class evident from age-6 fish suggests poor spawning year in 2004 but strong before and after; annual mortality is medium, may be signs of medium fishing**

		pressure on fish older than age-5 (18 cm)
	Growth	**Growth begins to slow at age-4 with significant reductions beyond age-6; growth rates are similar to other local lakes experiencing fishing pressure for this species**
Pumpkinseed	**Relative abundance**	**High abundance compared with other Buck Lake fish species; medium abundance compared with other local lakes sampled**
	Number of fish per net	**Medium number compared with other species in Buck Lake; medium number compared to other local lakes sampled**
	Lengths	**Mean length is the larger than the size at which anglers will first keep and large compared to mean lengths from this species in other local lakes sampled; highest abundance of 'keepers' compared with other local lakes sampled**
	Ages	**Good distribution of fish from age-4 to age-11; annual mortality is low compared with other local lakes sampled suggesting that this species is experiencing low fishing pressure**
	Growth	**Growth does not begin to slow appreciably until age-6 suggesting that maturity is delayed until this age; growth rates are similar to other local lakes sampled**

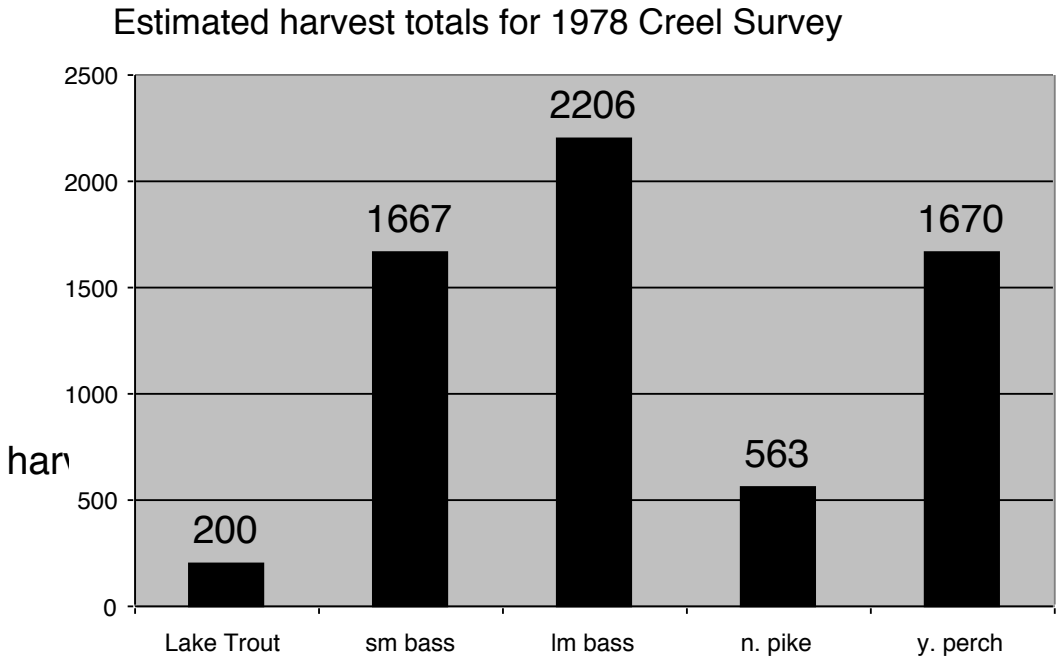
Fish Species	Indicator/Benchmark	Comments
Black crappie	**Relative abundance**	**Medium abundance compared to other Buck Lake species; medium abundance compared to other local lakes sampled**
	Number of fish per net	**Medium number compared to other Buck Lake species; medium number compared to other local lakes sampled**
	Lengths	**Smallest mean length of all local lakes sampled that contain this species; low abundance of 'keepers' even lower than Col By, a lake commercially fished for this species**
	Ages	**No fish older than age-5 present suggesting high angling pressure on this species**
	Growth	**Growth is significantly reduced beyond age-2 suggesting fish mature at this age, younger than other local lakes sampled; high angling pressure on older fish can cause fish to mature earlier to offset the mortality**
Brown bullhead	**Relative abundance**	**Medium abundance compared to other Buck Lake species; low-medium abundance compared to other local lakes sampled**
	Number of fish per net	**Medium number compared to other Buck Lake**

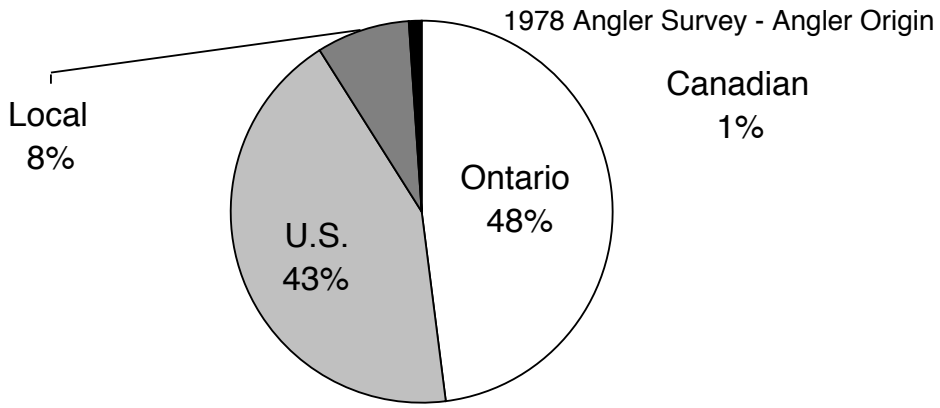
		species; medium numbers compared to other local lakes sampled
	Lengths	**Highest mean length compared with other local lakes sampled; high abundance of 'keepers'**

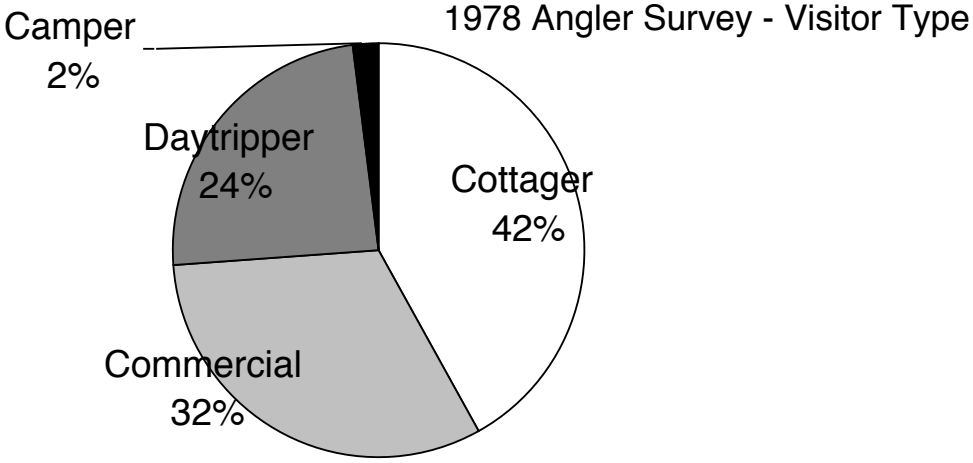
Creel Surveys, Angler Logs & Conservation Officer Logs

A roving creel survey was carried from May 5th to July 27th, 1978. This survey was carried out by boating around the lake and stopping to talk with anglers for an 8-hour period on 25 separate occasions. These 8-hour creel shifts were set up so that they sampled the entire fishing day from 6 am through 9 pm. A summary of this survey is as follows:

Month	**Fishing Effort (angling-hours)**			**Hours to Harvest One Lake Trout**
	Lake Trout	Other species	Total all species	(# lake trout/hr)
May	1117.67	3412.81	4530.48	20.7 (0.048)
June	941.99	2934.51	3875.50	No catch
July	1231.19	9664.31	10895.50	7.99(0.125)
Total	**3290.85**	**16011.63**	**19301.50**	**16.45**(0.061)







Some statistics were recorded by Conservation Officers during routine patrols on Buck Lake from 1968 to 1976. This data is summarized in the table below:

		Number of fish caught				
Date	**Angler Hours**	**Lake Trout**	**Small Mouth Bass**	**Large Mouth Bass**	**Pike**	**Perch**
June 1968	30				5	3
June 1968	45.5	2			5	
March 1969	396	27				
May 1969	98	9			2	
June 1969	16	1				
July 1969	40	1	5	9		4
February 1970	322	28				
March 1970	200	10		5		
July 1970	59	1		2		
February 1971	257.5	43				

May 1971	76	3			2	11
August 1972	40			10		
February 1973	389	25				
March 1975	856	38				
July 1975	107	1	17	13		
March 1976	458	40				